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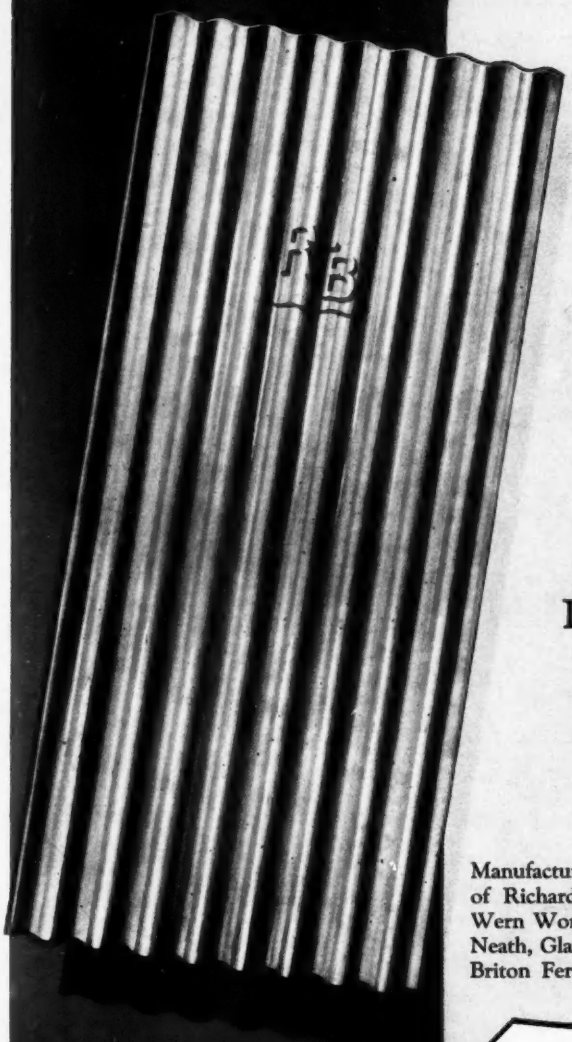

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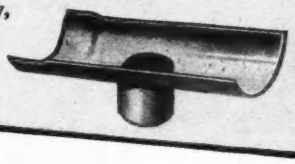

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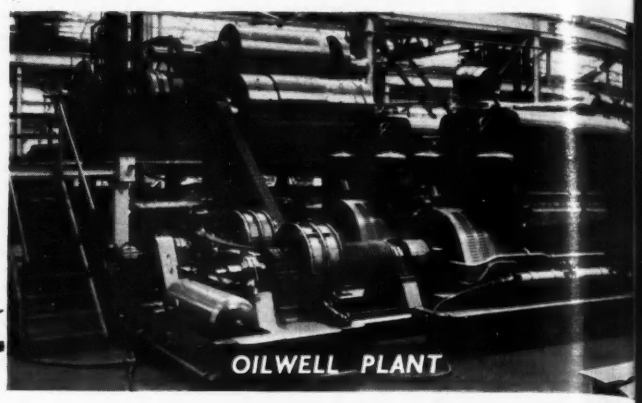

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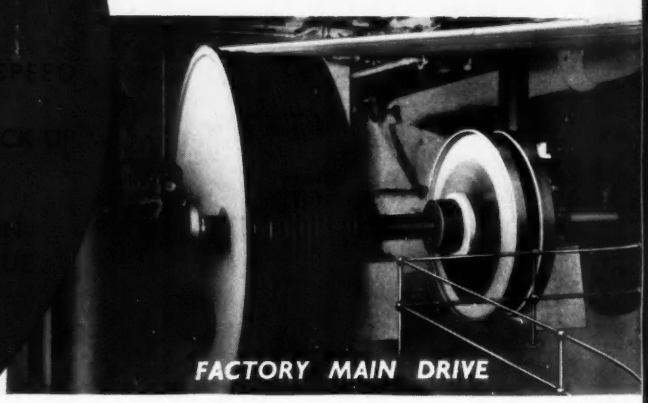

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A Seven-Day Journal

The Armaments Programme

THE House of Commons reassembled on Tuesday last for a special sitting, when a debate on defence needs was opened by the Prime Minister, the Right Hon. C. R. Attlee. The Prime Minister said that the Government was now implementing a policy of arms production and the House had already been informed of an immediate programme, amounting to £100,000,000, for the re-equipment of the Services. The make-up of that programme had been agreed and orders had been placed for aircraft and military and naval equipment to the value of £50,000,000, while many others were in process of negotiation. The programme, the Prime Minister stated, could be achieved by the expansion of existing capacity. Under the North Atlantic pact, Mr. Attlee continued, the United Kingdom had stated that it would be physically possible to undertake a programme which would, over the next three years, increase her expenditure on defence to a total of £3,400,000,000, but how far it would be possible to attain that level would depend on the amount of assistance forthcoming from the U.S.A. Later in his speech, the Prime Minister said that it was clear that the main weight of the additional production proposed must fall on the industries making capital goods, such as machinery, vehicles, ships, aircraft and electrical equipment. Estimates were being made of the extent of the burden on each industry, but he could not, at present, be too precise. One fact, however, was plain. Those industries which would be most affected accounted for over 40 per cent of our export trade, while much of the rest of their production went to essential home industries. It was precisely in that field, Mr. Attlee emphasised, that the competition between the needs of economic stability and of defence were greatest. As the programme gathered momentum, he added, there would obviously be an increasing demand for labour, possibly amounting at the peak to an additional 250,000 workers engaged in armament production. That increase, however, would be gradual.

Completion of the Fannich Tunnel

ON September 7th, the construction of the Fannich Tunnel of the North of Scotland Hydro-Electric Board was completed, with the removal of the final plug of rock between the tunnel and the bottom of Loch Fannich. Lady MacColl, wife of Sir Edward MacColl, Deputy Chairman of the North of Scotland Hydro-Electric Board, electrically detonated the charge which completed the tunnel. Sir Edward MacColl said that the Fannich Scheme would form one of a group of six stations which would supply energy to all the northern parts of Scotland. The Grudie Bridge (Fannich) station would make a very substantial contribution towards alleviating a somewhat difficult position so far as the Board was concerned, he added, and the station's output would be completely absorbed during this winter. The completion of the Fannich Scheme would also mark the beginning of a social experiment, continued Sir Edward, in that when the group of stations was completed, in fact, even before then, it would be operated remotely from a new village and control centre at Contin, about 12 miles away. Sir Edward remarked that contracts would be shortly let for two of the stations of the next development of the Conon Basin Group Scheme —the stations at Lochluichart and Torr Achilty —and later the stations at Glascarnoch, Achanalt and Orrin would follow. When completed, their combined power would be about 100MW, with an annual output in units of 450 million. The Conon Basin Group of stations, he said, was not being built as a peak load group but was intended to supply energy at high load factor for industries of whatever type may be located within the North of Scotland. Later, when the Board erected a 25ft dam at Loch Fannich, they would have a storage equivalent to 75ft, which would allow the Grudie Bridge station to run for a year even if they had no rain at all. He said that the Board hoped to complete the whole group scheme in about seven years' time. Two 12MW machines, operating under a head of 530ft, have been installed in the Grudie Bridge power station and are expected to commence operation in about a month's time. Construction of the Fannich tunnel, which is nearly 4 miles long, has been in progress for two and a half years.

British Trade Promotion Centre in New York

To assist British industrial representation in the United States of America, a British Trade Promotion Centre was opened at Fifth Avenue, 53rd Street, New York City, on Thursday of last week, September 7th. The management of the Centre is being directed by the British Commonwealth Chamber of Commerce in the U.S.A., with the collaboration of the Dollar Exports Board, The Federation of British Industries, the National Union of Manufacturers, the Scottish Council for Development and Industry, and the British Export Trade Research Organisation. It is stated that the main functions of the Centre will be to provide information, advice and help to British industrial organisations and individual firms on any and every aspect of exporting British goods to the U.S.A., and to represent the views of British industry to the American authorities and American business men. An important feature of the services available at the Centre is the provision of a number of offices for letting on a day-to-day basis to visiting British business men. The services of the Centre, it should be added, are offered to all representatives of British industry whether or not their firms are members of one or other of the participating organisations. The Centre has been set up entirely on the initiative of private enterprise and is supported by contributions from private enterprise organisations and firms. Commenting on its opening last week, Sir Robert Sinclair, President of the F.B.I., said that it was proof of British industry's determination to do everything in its power to close the dollar gap through the well-tried methods of private enterprise.

A Specialist Team on Galvanising

THE latest team to visit the U.S.A., under the guidance of the Anglo-American Council on Productivity, is one drawn from the galvanising industry. The team, which is under the leadership of Mr. F. C. Braby, chairman of the Hot Dip Galvanisers' Association, was due to leave this country yesterday, September 14th. This team is a specialist one rather than the normally constituted team, representing management, technicians and operatives. Its constitution was decided upon in view of the fact that galvanising as such cannot really be considered a separate industry in this country, although, of course, there are plants which specialise in it. It was felt, however, that as galvanising is one process in a large number of manufactures, the main need was for a survey by specialists of galvanising techniques in the U.S.A. The team consists of those experienced in all types of galvanising in this country, including that of tanks, hollow-ware, window-frames, marine equipment, nuts, bolts and small parts, and during the last few weeks its members have inspected several British plants. The American Hot Dip Galvanisers' Association is taking great interest in the visit and the plants of several of its member firms are to be inspected. Hand and mechanical dipping and the continuous process will be studied during the tour and special attention will be paid to general research on galvanising and to research on the corrosion of galvanised coatings. It is announced that the tour, which will not be completed until the end of October, will cover a wide area of the eastern half of the U.S.A.

Electronic Instruments in Research and Industry

A SYMPOSIUM and exhibition of electronic instruments in research and industry was held in London last week under the auspices of the Scientific Instrument Manufacturers' Association of Great Britain. Opening the symposium on Tuesday, September 5th, Sir Ben Lockspeiser, Secretary of the Department of Scientific and Industrial Research, said that, in spite of the great strides made in applied electronics in the last ten years, there was no limit yet to the horizon of discovery and invention. He had seen encouraging evidence of the results of collaboration between scientists and engineers in research laboratories and universities. The needs for instrumentation in industry varied considerably. The instrument requirements of a new chemical or refinery plant, for example, could easily absorb 10 or 20 per cent of the initial capital outlay. In general, however, it was the research worker rather than the industrialist who was responsible for putting pressure on the instrument maker. Sir Ben quoted the experience of the director of a leading British research laboratory during a visit to the U.S.A. He found that in a certain industrial process the Americans were using an instrument which helped them in the selection of their raw material, although the scientists were by no means certain of the quantity that the instrument was measuring. While the theory of the instrument was still the subject of scientific study, the industrialists were making practical use of the new development.

Association of Public Lighting Engineers

THE Association of Public Lighting Engineers is holding its annual conference in Bournemouth, from Monday, September 18th, to Friday, September 22nd. Among the 1000 delegates attending the conference will be visitors from Belgium, France, India, Spain, and other overseas countries. The conference and the associated exhibition of street lighting equipment will be officially opened by the Mayor of Bournemouth, Councillor S. A. Thompson, J.P., on September 18th. On the following day, after his induction as president of the Association for the ensuing year, Mr. P. Richbell will deliver his presidential address. The afternoon will be devoted to an address by Dr. J. W. T. Walsh on "The Draft Code of Practice for Street Lighting in Class 'A' Roads." Wednesday's session opens with a paper by T. Beecroft on "The Design of New and Modernisation of Existing Gas Street Lighting Installations on Group 'B' Roads." Lighting as a public amenity forms the subject of the paper to be read by E. B. Sawyer during the afternoon session. On Thursday morning, Mr. A. J. Harris will present a paper discussing some problems of road safety research involving the lighting of streets. At the subsequent annual luncheon, Lord Lucas, Parliamentary Secretary to the Ministry of Transport, will be the principal guest of the Association. The final session of the conference will be on Friday morning, September 22nd, when Messrs. W. E. Harper, P. H. Collins and H. P. Walker will present a paper and demonstration on the design and performance of acrylic street lighting equipment.

Productivity in British Industry*

No. XI—PRODUCTIVITY IN THE SMALLER ENGINEERING WORKS

By ANTONY VICKERS, B.Sc., M.I.Mech. E.†

HOW to increase productivity and, at the same time, maintain or improve quality with a reduction in costs is one of the "musts" of to-day, and doubtless there is no one solution. In the case of the smaller engineering works, which represent the bulk of production, the problem of productivity is possibly easier than with the larger works because so much depends on the combined endeavour of each and every member of the firm to do his or her best; and this in the ultimate depends on personal leadership at all levels of management. Without the will to achieve the best results the most modern mechanisation will fall a good deal short of expectations. Hence the problem resolves itself into one of developing the highest degree of industrial relations, coupled with the best technical performance.

In the firm with which the writer has been associated since its beginning in 1930, there are now 300 employees, and during the last three years output has been doubled with an increase of only 25 per cent in the number employed—productivity having been increased by 60 per cent. We realise that other firms have done better than this, and that there is much scope for improvement. Nevertheless, our methods may be of some interest to others, bearing in mind that the selling price of our product is about one-third of that of our American licensees!

Profit Sharing

The sharing of profits as between those that risk their capital and those that give their services, in whatever capacity, will, we suggest, become steadily more recognised, not only as equitable, but also as sound industrial practice. The rates of distribution may vary from firm to firm but, in this company, after everything has been paid for, including interest and 5 per cent on the capital employed in the business, the balance is divided as follows:—

10 per cent Welfare and Security.
30 per cent Reserve.
30 per cent Shareholders.
30 per cent Associates.

The policy of the company is threefold, and aims to give the most favourable product to the customer, the best return to the shareholders and the most attractive conditions of employment. In return, the company expects the best service of its employees who, after six months, can apply to become Associates and thereby become eligible for the benefits of the Welfare and Security Fund, as also for a share in the profits. Two conditions only are required for Associate membership. The first is the O.K. from the section chief or foreman, and the second is the acknowledgment of the principle that every privilege carries a responsibility. The application for membership therefore runs as follows:—

"I hereby apply for Membership in the ..... Associate Scheme in order to be eligible for participation in the Efficiency Bonus and enjoyment of the benefits of the Welfare and Security Fund. In doing so I willingly accept the principle that all privileges carry responsibilities and that the consideration on my part to qualify for these privileges and benefits is to satisfy the Management as regards my work and conduct."

It is hardly surprising that all employees, after serving six months, become Associates, that the labour turnover is practically nil and absenteeism is less than 0·7 per cent. (Maximum productivity is not possible with a high rate of labour turnover and absenteeism.)

The divisible profit is worked out at so much in the £ on basic salaries and wages, and at present is averaging 2s. in the £, being paid out as an efficiency bonus four times a year, before Christmas, Easter, the August holiday and once in the Autumn. In the event of a loss, which in fact happened during part of the post-war change-over period, the loss is carried forward until it is made good.

Seven years' experience convinces us that profit sharing pays valuable dividends over and above the actual financial distribution. One of these is the ability to build the true team spirit without which the best performance cannot be attained. Another is the educational value of relating financial results with individual effort. In the case of the Welfare and Security Fund, there is no doubt that its practical application to those in need creates a sense of confidence and humanity much above the average in industry.

It may be considered by some that we have over-emphasised the importance of profit-sharing schemes, but we can only repeat our considered opinion that sound industrial relations, together with a high sense of individual responsibility, are the right foundation on which to build the best technical practice.

Production Meetings

Efficient production from the technical aspect, as every engineer knows, depends on a variety of things, including:—

(1) The need to design each component with a view to the cheapest production consistent with the maintenance of quality and correct functioning.

(2) The most satisfactory layout of the works, aided by mechanical handling equipment, so as to reduce unnecessary labour and fatigue.

(3) The use of modern, highly efficient machine tools, together with the optimum usage of jigs and fixtures.

(4) A high degree of inspection to ensure the maintenance of the limits and tolerances laid down, and thereby reduce fitting times.

(5) Careful production progressing.

These problems concern the chief designer, the works manager, the shop superintendents and fitting shop foreman, the contracts manager and buyer, the chief inspector, the two executive directors and the secretary. Hence production meetings are held every week from 5.15 p.m. to 7.15 p.m., at which all of those mentioned take part. Practically every problem involves two or more departments and, in consequence, such meetings provide an admirable means of arriving at the best decision. Furthermore, that paralysing defect of "departmentalism" is eliminated, and a

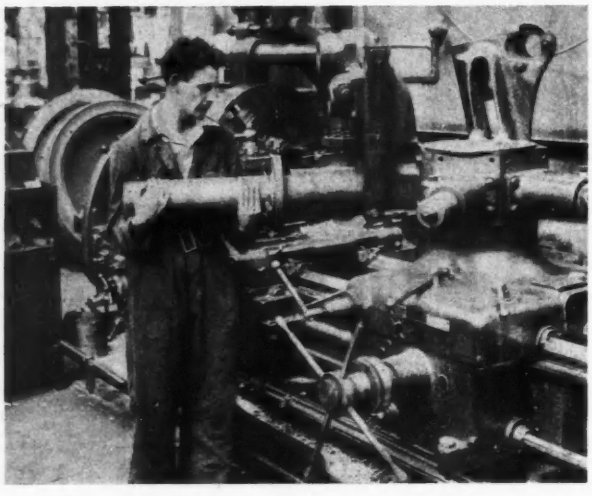


FIG. 1—PLACING SHAFT FORGING ON ADAPTOR

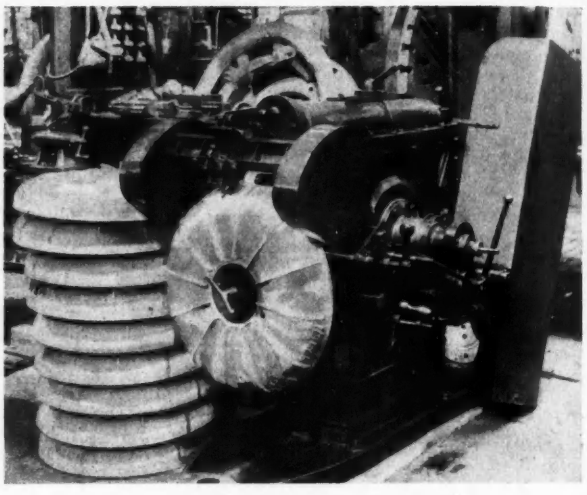


FIG. 2—MACHINING IMPELLER CASTING

* No. I, "An Introductory Survey," by B. White, appeared February 17th; No. II, "The Threshold of Productivity," by F. A. Martin, March 3rd; No. III, "High Productivity and Production Costs," by Sir Claude Gibb and Gordon M. Baker, March 17th; No. IV, "Standardisation in the Aircraft Industry," by E. C. Bowyer, March 31st; No. V, "Restrictive Practices," by Arthur Woodburn, April 21st; No. VI, "Research for Productivity," by Dr. D. F. Galloway, May 19th; No. VII, "Consequences of Simplification," by W. D. King and H. Sherburn, June 30th; No. VIII, "Works Extensions," by C. K. F. Hague, July 28th and August 4th; No. IX, "Mechanical Handling" by F. Garner and A. Siddall, August 11th and 18th; No. X, "The Importance of the Craftsman," by F. V. Everard, September 1st.

† Director, Hydraulic Coupling and Engineering Co. Ltd.

fine degree of understanding amongst all concerned is brought about.

It is, however, very important that responsibility should be widened as far as practical and an opportunity afforded of bringing forward both suggestions and difficulties. In consequence, once a month, the production meeting is extended to include foremen and chargehands, head store-keepers, and the assistants to the department managers. Here again, an excellent opportunity is provided of building up a first class team !

Lastly, so that all Associates may participate, a meeting is held every second month, immediately after the works close, at which items of company interest are discussed, including the annual accounts. At four of these meetings the quarterly bonus is declared, and every endeavour is made to encourage the feeling that everyone is important to the business, whatever their particular job may be.

Some Examples of Increased Productivity

As the late Mr. Henry Ford so rightly said —"There is nothing that cannot be done better"—and, therefore, it should be possible to improve on the production of every component. In some cases the improvement achievable is not worthwhile in terms of capital expenditure but, as the volume of production increases, the position continually approaches the time when a change in method may become worthwhile. In consequence, a live production department will always be seeking new and better methods, some of these in our case being as follows :—

FIG. 3—U-SHAPED HEAD ON BORING MILL

Formerly a light overhead crane with leather sling was used for lifting shaft forgings into the chucks of our semi-automatic turret lathes. The weight of these shafts could easily be lifted by a man, but he could not reach over the bed of the lathe with the shaft. A simple tubular adaptor, as shown in Fig. 1, was therefore made up which fits into the turret, the man having no difficulty in lifting the shaft into the adaptor. The turret is then rotated and fed forward, carrying the shaft into the chuck. Loading time has been reduced to one third, and the machine operator is entirely independent of the crane, which is thus available for other work.

The time for machining the backs of aluminium impeller castings having a series of protruding vanes was reduced to one-tenth, as compared with the orthodox method of milling involving special form tools. A standard shaping machine was adapted, as in Fig. 2, so as to give a radial motion to the single point tool and a simple feed mechanism caused the impeller casting to be rotated.

In the case of the machining of the steel reservoir casings on vertical boring mills, our former practice was to use a single point tool in separate operations for both the inside and outside. By making up a special " U "-shaped head for the vertical slide, as in Fig. 3, two cutting tools now machine both inside and outside of the cylinder in one operation. This represents a saving in time of better than 50 per cent because, with single point tooling on one side only, only a light cut can be taken due to the possibility of deformation of the casing.

Perhaps one of the biggest time-savers in the machining of shafts, half-couplings and so forth is achieved by the George Fischer Copying Lathe, shaft times being reduced to one-quarter as compared with our present machining practice in a semi-automatic turret lathe. Such a machine tool has recently been installed.

Points of Detail

A hundred and one points of general detail could be mentioned, all of which have an influence on productivity, but space permits the mention of only a few.

Pride in one's machine tool, as well as the workmanship put into the job, is of major importance. Thus, when a new high production tool is purchased, costing, perhaps, £5000 or more, the facilities offered by the machine tool maker for the operator to receive special training on the machine before leaving their works are readily accepted by us. In doing so, the operator not only has a first-class opportunity of learning how to get the best out of the machine, but also gains a sense of importance and responsibility.

Manners and respect from top to bottom and bottom to top count for much in any organisation, and not least in helping productivity.

Conclusion

The will to do his or her best for the firm is, perhaps, the most valuable of all factors in obtaining a high degree of productivity, particularly when it is associated with the most up-to-date technical performance. But whereas the latter depends more on material things, the former depends on the understanding of human beings, and without this management will not get the best results. Seven years' experience of profit sharing have convinced the writer of its value in building up team spirit and the sense of individual responsibility. It also has the tremendously worthwhile quality of relating profit to effort.

On the negative side, there are many things that reduce productivity to the lowest levels, but perhaps none is more devastating than the fear of working oneself or one's mate out of a job. In the case of the non-expanding industries, such as coal, railways, and docks, the full and effective use of mechanisation could doubtless double productivity within ten years. But to bring this about 700,000 people would have to transfer and be welcomed into other industries during this period. Purchasing power would have to be increased accordingly and, without this, productivity will remain stagnant. The problem is so much greater than in the expanding industries, where redundancy of labour is not a major factor. Surely there is a better answer than nationalisation.

South African Engineering News

(From our South African Correspondent)

"Constellation" Aircraft

Preparations for the addition of pressurised "Constellations" to the fleet of South African Airways are well advanced, the first of four being due to arrive in the Union in May, while the remaining three will arrive during the following months at the rate of one a month. They are of the type " 749 A."

Cyanide Production

Probably the most useful industrial enterprise in the Union is that controlled by African Explosives and Chemical Industries, Ltd., which produces explosives, industrial chemicals and fertilisers in several plants in the Transvaal, in Natal and in the Cape. Owing to the big expansion in mining, the sale of explosives last year reached the record total of 2,973,306 cases, and the demand is increasing. An interesting addition to the company's activities is the production of cyanide, used in the gold mining industry. This commodity was formerly imported. The factory at Klipspruit, next to Johannesburg's largest sewage disposal works, is now, after initial difficulties, producing about one-third the mines' requirements, or over 3000 tons per month. A process is used by which the sewage gas, consisting of about one-third carbon dioxide and two-thirds methane, is drawn off and used to form the cyanide. The purified effluent from the sewage works is used for cooling the cyanide factory's plant, and the hot water goes back to the sewage plant to heat the digestion system, thus releasing more gas.

Electricity Supply Developments

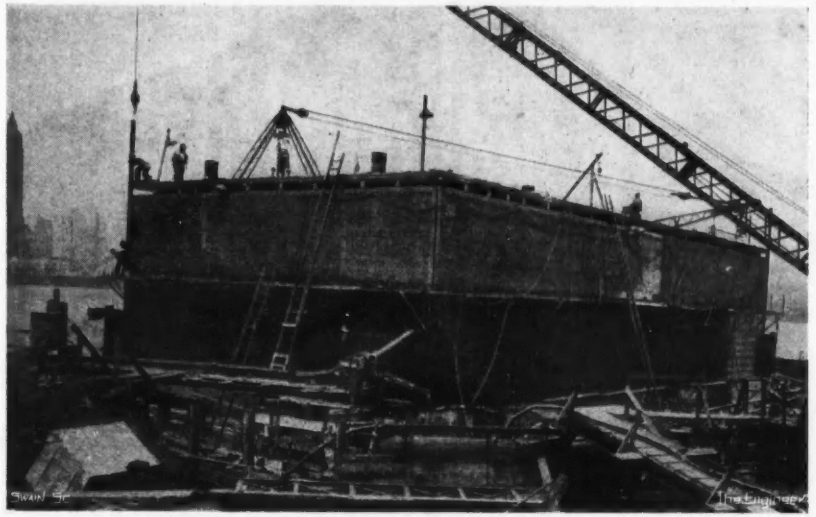
Johannesburg municipality has recommended that another large power station should be built at Lombardy at an estimated cost of £8,000,000. Accordingly, their engineering consultants are to prepare detailed costs for the first portion of such a new station.

Of some interest in recent South African power station developments is the agreement recently signed between International Combustion (Africa) and James Brown, of Durban, for ten of the largest mechanical stokers ever to be manufactured. Four of these stokers are for the new power station at Pinetown, and the other six for the new Electricity Supply Commission power station at Vierfontein, in the Free State.

Livingstone Aerodrome

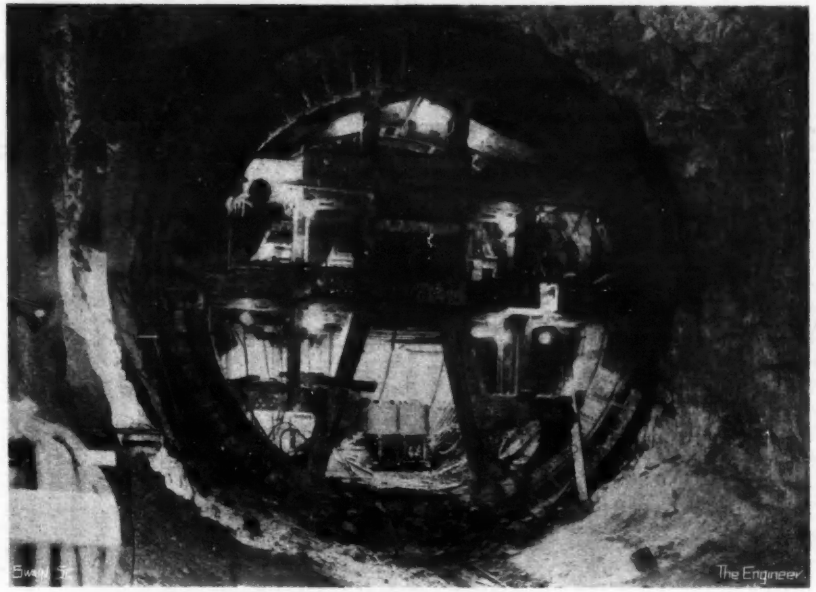
The main runway of the new Livingstone aerodrome, stated to be the largest in Africa, has recently been completed. It has been tested by engineers from the British Air Ministry and pronounced fit to take the largest aircraft in the world, including the " Brabazon." The runway is more than a mile and a half long by 200ft wide, and has a bituminised surface. It is 14in thick for the greater part of its length, thickening to 17in at each end. A subsidiary runway is also nearing completion, which will be long enough to take all but the largest aircraft. The airport's control tower is at roof height, and the main hangar, measuring 146ft by 250ft, is completed except for a small part of the roofing. Sub-contractors are now at work installing the runway lighting, which is similar to that at London Airport.

BROOKLYN-BATTERY TUNNEL, NEW YORK

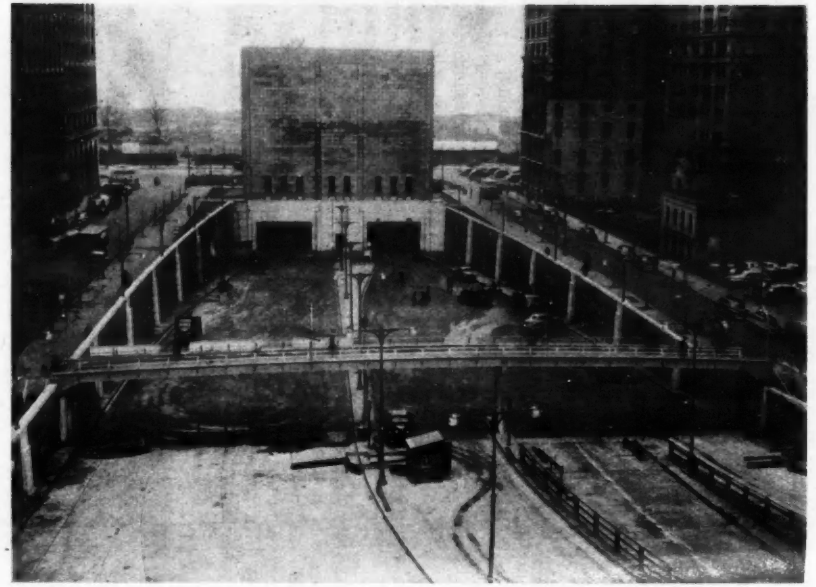


CAISSON FROM GOVERNORS ISLAND VENTILATION SHAFT

COMPLETED TUNNEL INTERIOR



FRONT ELEVATION OF SHIELD, CONTRACT 6



MANHATTAN PORTAL WITH VENTILATION BUILDING AND PEDESTRIAN BRIDGE

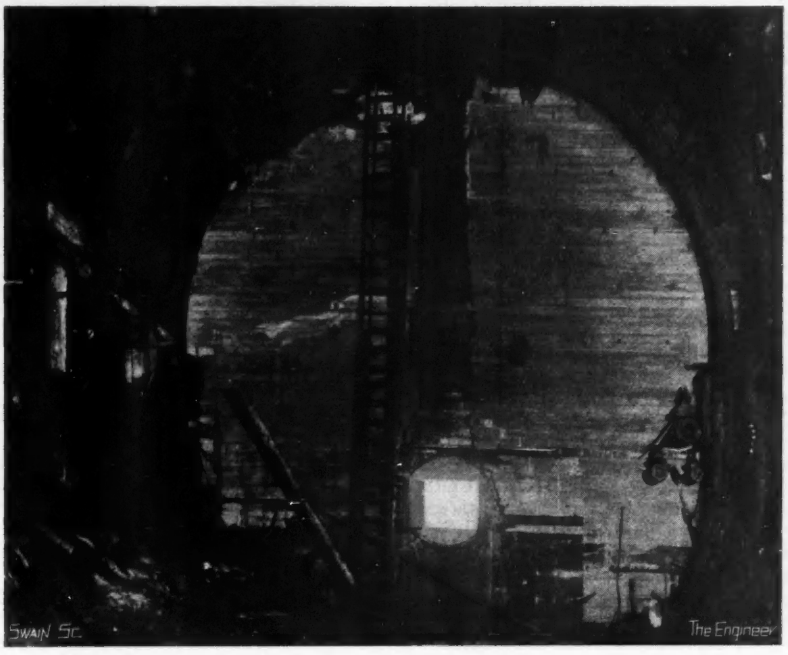
Brooklyn-Battery Tunnel, New York

No. II—(*Continued from page 245, September 8th.*)

A SINGLE construction shaft, which was sunk in Battery Park by A. D'Angelo and Sons, Inc., was the operating starting point from which the twin tubes have been driven from the Manhattan end of the undertaking. Nothing notable occurred during the sinking of this shaft, and it was ready for use when Mason and Hanger Company, Inc., took it over to begin tunnelling work under Contract 6 late in October, 1941, for driving a distance of 2800ft through rock toward Governors Island. The single shaft, at its bottom, had a chamber 30ft wide and 82ft long, with provision for a central transverse wall that will divide the compartment into two chambers, with a connecting passageway between them, when the tunnelling work is completed.

The plan was to begin the tunnelling by driving in each tube a 20ft by 20ft bottom drift all the way from the Battery shaft to the vicinity of Governors Island, and ultimately to Governors Island as the contract was extended, as will be explained later. The initial headings were on a descending grade of 3·5 per cent in the case of the east tube and 3·9 per cent for the west tube, the west tube being designed to carry traffic southward from Manhattan to Brooklyn and the east tube to accommodate traffic moving northward from Brooklyn to Manhattan, and the lower gradient was to ease the climb. Shield driving was not specified under the Mason and Hanger contract, but when the contractor realised that he would have to pass the valley in the rock beneath Battery Park, under compressed air, as was specified for use in the "valley" and for bottom drifts in this section, he provided himself with shields to facilitate enlargement operations. The initial crossing of the valley, however, was accomplished in mixed ground using compressed air, but without the use of shields, but headway was slow. In the case of the west tunnel where the lowest point in the "gorge," as it was generally called, was below the invert of the tube roadway, the length of that rock gap was 100ft at the top of tunnel.

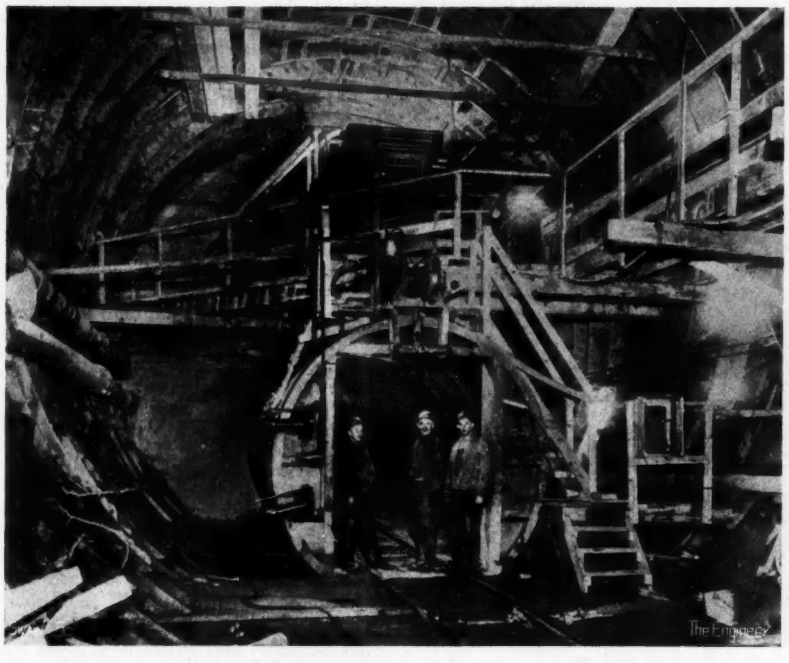
When the bottom drift in each tube reached a point where the rock indicated nearness of the valley, a concrete bulkhead, with locks, was erected rearward and the intervening tunnel section was placed under compressed air and concreted as the heading was advanced. No trouble was experienced in controlling such water as worked its way into the drift. The driving of the drifts, about 60ft long, across the valley occupied April, May and June of 1942—April and May for the east tunnel and May and June for the west tunnel. After clearing that gap, the drift was generally increased in section to 24ft by 24ft. The maximum air pressure while getting through the valley was 17 lb, and that portion of the tunnel was liner-plated and concreted. The advance was continued southward with the excavation of the drifts until halted by the war, with the heading in the east tube 2818ft from the construction shaft, and the heading in the west tube drift 2826ft from the same starting point. When operations were brought to a standstill, all equipment likely to be damaged by water was withdrawn and both tubes were permitted to fill with seepage.



NORTH FACE OF SOUTH AIR BULKHEAD, WEST TUNNEL, CONTRACT 6

When work was resumed, November, 1945, the two tubes had to be unwatered, which took several weeks. The 24ft by 24ft drifts were thereafter driven steadily towards Governors Island with the headings reaching their southernmost halting points by the end of March, 1946, just beyond the area to be penetrated in the sinking of the Governors Island ventilation shaft.

Inasmuch as the work to be done under Contract 7 could not be awarded on schedule on account of war restrictions, when Contracts 5 and 6 were resumed in 1945, Mason and Hanger was given the remainder of the tunnel driving on the north side of the ventilation shaft site which explains why the 24ft by 24ft drift was driven all the way to Governors Island. After reaching that southernmost point, under Contract 6, Mason and Hanger reversed their operations by back-tracking northward to enlarge the excavation to the construction shaft in Battery Park. The enlargement was done by ring-drilling for about 150ft to accommodate a larger drill jumbo that was to be used in excavating the full circle of 31ft diameter. The preceding drift was driven by horizontal drilling, using delay detonators for firing. The enlarged bore was a trimming job, and also horizontal drilling, the advance being variable because of changing condition. In the initial drift, the average advance was 15ft a day in the full rock headings. Bad and seamy rock was



NORTH FACE OF NORTH AIR BULKHEAD, EAST TUNNEL, CONTRACT 6

encountered close to Governors Island during the enlargement, and the contractors had to make use of steel-rib support. The rock became better as progress continued northward. The advance made with each round during the enlarging work averaged about 10ft. About May 1, 1946, when engaged in the enlargement of the original drift, that operation was interrupted for a short while to engage in mucking the invert and in placing the concrete cradle upon which the shield in each tube was to travel. The shields were to be used in getting through the rock valley near the Battery Park shore line, and in placing the cast iron tunnel lining, which, except in the mixed ground sections, is of the light type, i.e., 12·5 tons per ring. In the work of placing the cast iron lining the contractor has erected up to fifteen rings a day in each of the twin tubes.

The Mason and Hanger power plant, located in Battery Park close to the construction shaft, contained three low-pressure compressors having a combined capacity of 16,800 cubic feet per minute, and two high-pressure compressors, with a total capacity of 5200 cubic feet per minute. The latter air was used in the tunnel and in the plant to operate drifters, air hoists, jackhammers, paving breakers, sump pumps, concrete vibrators, and miscellaneous tools and riveting hammers in the repair shop.

Just as a chain is only as strong as its weakest link, so is the strength of the cast iron tunnel lining, whether in rock, soft ground, or mixed ground, dependent upon the prescribed tightening of each and all of the assembly high-tensile steel bolts. It may also be said that the appearance of the interior finish of a subaqueous tunnel can be marred by leakage, even small in amount, through imperfectly tightened and caulked seams in the lining. On this point, we have this pronouncement of the tunnel engineers: "It is of great importance to reduce the leakage in a vehicular tunnel, which is continually subject to the scrutiny of its patrons, to an absolute minimum. It has been found that a very small disturbance of the lead-wire caulking in the caulking grooves between lining segments will damage the waterproof qualities of the lead-caulked joint considerably. In the light cast-iron lined sections of the Brooklyn-Battery tunnel, which, being more flexible than the heavy lined section, are more subject to erection distortions which may cause subsequent leakage, the specifications called for machine bolting, for uniformity, to a minimum bolt stress of 30,000 lb per square inch. It is anticipated that the change in specified bolting methods and increase in minimum bolt stress from the 25,000 lb per square inch as heretofore specified, to 30,000 lb per square inch, together with the erection of the lining as nearly as possible in its designed circular form, will effect an improvement in the waterproof qualities of cast-iron tunnel lining." To this end, engineers of the Tunnel Authority and engineers of Mason and Hanger developed a pneumatically-operated bolt tightener capable of exerting a unit tension of 30,000 lb per square inch. The apparatus is supported on a curved steel traveller in a way that makes it possible for the tightener to be swung readily so as to meet any bolt within the circumference of a ring of lining. Each shield carries a number of these tighteners. The nuts generally are run on the bolts to their initial seatings by pneumatic track wrenches or "mules" and then tightened by the new equipment.

The packing and the grouting of the space between the excavated rock and the outside of the tube lining, as well as the grouting, kept pace with the erection of the tube lining. The interior lining with concrete was started in the early part of 1948; and, as is now standardised practice, collapsible steel forms were being utilised, to some extent the placing of concrete being done pneumatically. That lining normally has a thickness of 14in, and throughout the roadway areas, the walls and ceilings were faced with ceramic tile. Between kerbs, the roadway in each tube has a width of 21ft 4in and is paved with a wearing surface of brick. Concrete was placed to cover the cast iron ring flanges to a normal minimum of 2in. Each roadway is wide enough for two lanes of traffic moving in the same direction; and the minimum headroom between roadway and ceiling is 13ft 6in. Tunnel lighting is by two continuous lines of fluorescent tubular lamps instead of by the intermittent incandescent lamps heretofore installed in such tunnels. The lamps consist of two 6ft fluorescent units set end to end inside a 2½in diameter pyrex glass tube. In turn, the pyrex tubes are inserted into cast bronze boxes which carry the lighting transformers and are set into the tunnel ceiling. The light output may be varied, but, generally, operates to give an intensity on the roadway of 4 foot-candles.

The ventilation system of the Brooklyn-Battery tunnel is fundamentally based upon the method so painstakingly worked out and thoroughly tested in advance for the Holland tunnel. In principle, the fresh air is introduced to the driveway area just above the kerb level and delivered from the fresh-air flues spaced at intervals on each side of the roadway—the longitudinal space beneath the roadway of each tube serving as a voluminous duct for the transmission of fresh air from the blower plants. Vitiated air is removed from the driveway area through the air ports in the ceiling and is drawn out of the driveway into the large duct above the ceiling and carried thence, under the impulse of exhaust fans and delivered to the exhaust stacks at the ventilation buildings that carry the vitiated air high aloft to the free atmosphere. In the case of the Brooklyn-Battery tunnel there are three ventilation stations—one adjacent to each portal, and a central one, because of the length of

EXCAVATING TUNNEL INVERT, CONTRACT 6

STEEL ROOF SUPPORTS, CONTRACT 6

the tunnel, in mid river, tapping the tunnel at its lowest point and rising above the surface of the water on a man-made island, close to Governors Island, and where it does not restrict the much-used southern passageways of the East River. This ventilation shaft and its surmounting structure are covered in Contracts 7 for the shaft and 18 for the building. The contract for the shaft was awarded the Grow Construction Company, and work started on that job during the second half of 1946.

The Governors Island ventilation shaft was sunk by the so-called sand-island open-caisson method. The temporary island was constructed of sand, clay and riprap deposited on an area where the bottom silt and other materials were dredged to a depth of 55ft, and then refilled with the materials necessary to support the caisson, and stabilised with riprap. A bulkhead of piles rising from that island further protected the area on which the steel-and-concrete caisson was assembled in preparing it for sinking. The depth to rock was about 75ft below mean high water at the shaft site. The rectangular caisson, outside-to-outside of main skin plates, had a length of 111ft 1½in, and a width of 51ft 1½in. There were three open rectangular wells in the caisson surrounded by steel and concrete walls 6ft 6½in thick, with intervening divisional walls 4ft ½in thick. The steel structure had horizontal wall trusses and outside and inside steel plates. From the cutting edge to top of walls, the caisson had a maximum height of 74ft 8in, with a steel column and beam structure for an additional 11ft 4in above the top of walls. At 50ft 11in above the cutting edge, the outer walls changed from 6ft 6½in in thickness to 5ft ½in in thickness up to the top. On reaching the rock at El. 223, the cutting edge was sealed into the ledge. The caisson was sunk by dredging in the open wells; and the structural steel was added and the walls concreted as the caisson sank. It was necessary to work under compressed air in making the rock seal. The shaft thence was sunk to the tunnel line, and to the ultimate maximum depth of 139ft below mean high water, in rock in free air. It was also rectangular in section, had a length transverse to the tunnel tubes of 97ft 4in and a width of 37ft 4in inside dimensions. The lowermost section of the shaft served as a sump with a pump room above.

The ventilation building, which surmounts the shaft, is an octagonal structure, 125ft by 125ft, and rises 126ft above mean high water to the tops of the evase stack, with a facade of light-coloured ceramic iron-spot face brick, with granite base and trimming. It is supported on the ventilation shaft and on eight 5ft 6in in diameter steel cylinders that were sunk to ledge rock and outside the shaft. There is a surrounding fender structure that rises directly from the water. The Governors Island ventilation building houses twelve blower and twelve exhaust fans; the blower building at the Manhattan portal contains seven blower fans. Eight exhaust fans are housed underground in Battery Park, with an exhaust outlet rising above ground with appropriate architectural treatment and landscaping. The ventilation building, near the south portal, in Brooklyn, has a plant consisting of eight blower and six exhaust fans. All told, these three plants provide a normal maximum of fresh air of about 4,200,000 cubic feet per minute—the equivalent of forty-two complete air changes within the two tubes each hour. The fans, motors, and transmission were supplied by the B.F. Sturtevant Company.

The driving of the twin tubes between the three construction shafts and the completion of those twin tunnels represent the major features of the Brooklyn-Battery tunnel; but construction work northward from the Manhattan construction shaft and the corresponding work southward to the Brooklyn portal and plaza were essential features of the undertaking and involved heavy outlays. The distance between the Manhattan portal and the construction shaft in Battery Park is approximately 1000ft and the work on that section included a special structure at the blower building, 190ft of steel bent and concrete structure, and approximately 740ft of reinforced concrete structure built in open cut. The joint contractors for the underground work in this section were the Gull Contracting Company, Inc., and L. G. DeFelice and Sons, Inc. An entrance underpass connecting with West Street has been linked with southbound traffic on the West Side Express Highway—an elevated structure that was extended southward on West Street to tie in with the Brooklyn-Battery tunnel. By this means, a large percentage of motor-vehicle traffic formerly crossing lower Manhattan to reach the three lower East River bridges *en route* to Brooklyn now relieves the bridges by using the more direct and speedier flow of traffic headed for Brooklyn. Oppositely, similar traffic bound northward from Brooklyn now has access to the same West Side elevated highway by conveniently placed ramps connecting with the uptown side of that elevated route. East River Drive, which has its southern end near Battery Park, is a recent development of Manhattan's trunk highways and skirts the East River shore for miles. Interchange between the Manhattan Plaza of the Brooklyn-Battery tunnel and the East River Drive will be by means of a Battery Park underpass, which is being constructed by the municipal government of the Borough of Manhattan. The underpass, in addition to connecting with the new tunnel will provide a tunnel route to the east side of Manhattan and to the Borough of The Bronx, or to points north or east in New England.

The Brooklyn Plaza is on Hamilton Avenue, approximately 3000ft inshore from the Brooklyn pierhead line, and connects by ramps leading to and from the elevated highway over Gowanus Canal and, again, by referring to the general plan of the Brooklyn-Battery tunnel, the interchange between the Brooklyn Plaza and important routes to motor vehicles is manifest. Broadly stated, the Brooklyn-Battery tunnel lends relief where it has long been needed, and, in effect, provides a main artery for vehicular circulation capable of fulfilling the requirements of existing motor traffic and any increase in volume for years to come. Exclusive of real estate values, the cost of construction of the tunnel was 83,000,000 dollars. Financing is by means of a toll charge, at present at the rate of 35 cents per passenger vehicle. The capacity of the crossing is estimated at 16,000,000 vehicles per year. Construction of the Brooklyn-Battery tunnel required the excavation of 813,000 cubic yards, the placing of 205,700 cubic yards of concrete, and involved about 85,000 tons of cast iron tunnel lining.

Battery Park, which has been closed to the public since 1941 as a result of the construction of the tunnel, is now being reconstructed. The Battery Parking Garage, the first publicly owned garage within the City of New York, was completed in July. It is situated at the Manhattan portal of the tunnel, and will accommodate 1050 vehicles on seven parking floors reached by a system of ramps.

The work on the Brooklyn-Battery tunnel has been under the general direction of the Triborough Bridge and Tunnel Authority.

Diesel Engine for Road Transport

THE range of engines manufactured by Henry Meadows, Ltd., of Fallings Park, Wolverhampton, has been augmented by a new 5·43-litre, four-cylinder diesel engine under the mark 4.DC.330. The introduction of this new unit is the result of the demand of commercial transport undertakings for more power, without increase in engine size, to drive the longer passenger vehicles now permitted and also to haul the increased amount of freight diverted to road transport. The compact engine now developed is suitable for vehicles with a load capacity of 6 to 8 tons and is equally able to fulfil the duties of an industrial prime mover for compressors, welding and generating sets.

Particulars

The clean appearance of the engine can be seen in the first illustration. It is a four-stroke overhead valve engine and (as shown in the curves overleaf) develops 80 b.h.p. at a maximum speed of 2200 r.p.m., the maximum torque of 230 lb-ft occurring at 1400 r.p.m. and corresponding to a b.m.e.p. of 105 lb per square inch. The cylinders have a bore and stroke of 120mm, giving a swept volume of 5·43 litres, the compression ratio being 16 to 1 and the customary Meadows' practice of incorporating harmonic balance gear to eliminate vibration due to secondary forces is maintained. Cooling is by water and starting is by means of a 5in axial motor in association with a hand-operated decompressor gear, although hand starting can be arranged. For power starting the manufacturers recommend the use of 24V battery equipment. A vee belt from the crankshaft drives the water pump, fan and a 12V swing-mounted dynamo and provision is made for driving a compressor or exhauster. The engine in its present form has a length of 35·6in from fan to flywheel face, an overall width of 22·25in and a height of 40in from the bottom of the sump to the top of the water outlet pipe. Including the flywheel the engine has a dry weight of 950 lb.

Materials and Design

For rigidity the crankcase and the cylinder block is a monobloc casting in high-duty iron, and a full-length water jacket surrounds the cylinders. The crankcase has five main bearing caps located by ring dowels and secured by studs and the cylinder block houses the high camshaft, access to which is by a side door extending the length of the block. The cylinder head, which can be removed without affecting the timing, is in two separate units of high-grade cast iron, each covering two bores and incorporating a short pedestal bracket to support the rocker fulcrum tube.

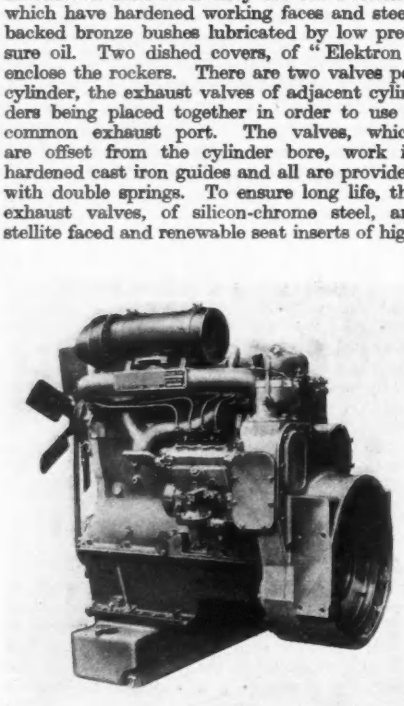
Removable wet liners, centrifugally cast in special iron, are located by a flange at their upper ends, sealed at their lower ends by synthetic rubber rings and jointed by soft copper rings. There are two sumps, both are "Elektron" castings, and the lower sump of pannier pattern has a capacity of 3 gallons. A forged steel flywheel is fitted and the gearcase cover and the flywheel housing are cast in "Elektron."

Each aluminium alloy piston has a toroidal combustion chamber machined in the crown, with three compression and one scraper ring above the gudgeon pin and one scraper ring below, all the rings being of parallel section

with the top ring chromium faced. The fully floating gudgeon pin is held between circlips in the piston and the connecting-rods, which are high-tensile steel stampings, can be withdrawn upwards through the bore, the small end being fitted with a steel-backed bronze-lined bush and the big end having a steel-backed bearing lined with copper-lead and lead-indium treated. A hole drilled lengthwise through the connecting-rod allows lubricating oil from the big end bearing to reach the gudgeon pin.

Of forged high-tensile alloy steel, the crankshaft has all bearing surfaces hardened by the "Tocco" electrical induction process and is supported in five bearings, which are steel-backed and lined with copper-lead and then plated with lead-indium. Thrust washers at the centre bearing locate the crankshaft, which is very rigid due to the considerable overlap given by having crankpins of 3in diameter and main journals of 3·35in diameter. The crankpins are eccentrically bored and closed by steel plugs retained by through bolts. Lubrication of the main bearings is effected through four holes leading from an annulus behind the bearing shells, the oil being fed to this point from crankcase drillings. Oil also reaches the big ends from the main bearings through drillings in the crank webs.

Cast in special iron with chilled cams the continuously lubricated camshaft is carried in five thin-walled bushes lined with white metal and driven by helical gearing from the flywheel end of the crankshaft. Chilled cast iron piston tappets and short push-rods operate the overhead valves through rockers machined from alloy steel. The tappets are of large diameter, carried in the cylinder block and the push-rods are electrically upset, have hardened ends and work in aluminium alloy tubes. Two pedestal brackets in each head carry the valve-rockers, which have hardened working faces and steel-backed bronze bushes lubricated by low pressure oil. Two dished covers, of "Elektron" enclose the rockers. There are two valves per cylinder, the exhaust valves of adjacent cylinders being placed together in order to use a common exhaust port. The valves, which are offset from the cylinder bore, work in hardened cast iron guides and all are provided with double springs. To ensure long life, the exhaust valves, of silicon-chrome steel, are stellite faced and renewable seat inserts of high

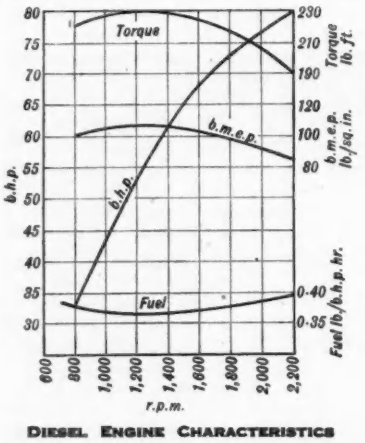


MEADOWS 4DC 330 DIESEL ENGINE

chromium iron are provided for both inlet and exhaust valves.

The balanced gear, lying below the line of the crankshaft, consists of two contra-rotating shafts driven from the crank-gear at twice the engine speed and carrying out-of-balance masses concentrated at the centre main bearing. Supported in white metal lined bearings, in extensions from the rear and centre main bearing caps, the shafts run under high pressure lubrication. The helical timing and auxiliary gear train are housed in a casing at the rear of the cylinder block.

A multiple plunger injection pump incorporating a diaphragm fuel lift pump, a maximum fuel stop and an excess fuel device, delivers fuel through a four-hole long stem injector, set at 175 atmospheres and at 20 deg. from the vertical, a copper sleeve passing through the water jacket, taking the body of the injector. Flange-mounted on the engine side of the gearcase and spigoted to ensure rapid alignment, the pump is driven through dog couplings, the drive, together with the speed governor, centrifugal head, and the pump operating levers being located in the rear side of the gearcase. The speed governor centrifugal head is driven at high speed by the pump gear, which incorporates the advance



DIESEL ENGINE CHARACTERISTICS

governor, a device which advances the point of injection with increase in engine speed to give economic fuel consumption over the whole speed range.

A belt-driven 4in diameter centrifugal pump, which has an 18in diameter fan mounted in tandem, delivers water to the cylinder block gallery, from where it flows, through a gasket, to the cylinder heads, through cored passages to the valve seats and injector sleeves and via a bleed to the cylinder barrels. An external pipe delivers the water to the radiator and a thermostat ensures that the engine quickly reaches its operating temperature, the cooling water being by-passed during warming up.

Pressure lubrication is by means of a Hobourn-Eaton Rotor oil pump, the oil passing via an external relief valve to twin filters and the main oil gallery to the main bearings. A pressure reducing valve provides oil at 5 lb for the rocker gear.

Air is drawn through a combined cleaner and silencer mounted direct on to the air inlet manifold, cast in "Elektron," and having individual ports to each cylinder. Below the air inlet is the two-branch cast iron exhaust manifold with each branch taking the exhaust from two cylinders.

The engine, which is at present undergoing proving trials, will be on view at the Commercial Transport Exhibition, and it is expected to be in production in the late autumn.

Fatigue Strength of Steel at Low Temperatures

IT is a well recognised fact that both the tensile strength and the fatigue strength of steels increase with fall of temperature below normal. In this connection, however, there is still conflicting evidence on some points, for example, the effect of temperature on the ratio of fatigue limit to tensile strength, and on notch-sensitivity in tensile and fatigue tests. Thus, out of nine cases quoted by Major Teed[1] from published results of tests at room temperature and at —40 deg. or —78 deg. Cent., the ratio of fatigue limit to tensile strength is decreased at the lower temperature in four cases, increased in two and remains about the same in the other three. Similarly, there is conflicting evidence about the effect of a notch. According to M. Hempel and H. Luce[2] the ratio of the fatigue limit of an unnotched specimen to that of a notched specimen increases with fall of temperature; that is, the fatigue limit of the unnotched specimen rises more rapidly than that of the notched specimen with fall of temperature. W. D. Boone and H. B. Wishart[3] on the other hand, come to the opposite conclusion, viz., that the notched specimen shows the more rapid rise in fatigue limit so that the ratio falls. The discrepancy may be due to different conditions of test.

Both the outstanding questions referred to above have been studied by A. Pomp and M. Hempel[4] in a comprehensive investigation of nineteen heat-treated low-alloy steels, four of which were castings. These were tested in various conditions of heat-treatment at +20 deg. and —78 deg. Cent. Tensile, impact and hardness tests were made at each temperature as well as fatigue tests on notched and unnotched specimens. The form of the notch was the same as that used by Hempel and Luce[3], viz., 60 deg. V, root radius 0·1mm, 0·5mm deep, in a test-piece 8mm diameter.

With the unnotched fatigue specimens the endurance limit (5 million reversals) increased at the low temperature to about the same relative extent as did the corresponding tensile strength. For the wrought steels, the general average of the ratio of fatigue limit to tensile strength was 0·458 at +20 deg., and 0·459 at —78 deg. Cent.; this, however, was made up of eleven instances in which the ratio increased, sixteen instances in which it diminished and five in which it remained the same within 0·005. For castings the ratio of fatigue limit to tensile strength was lower (0·25 to 0·33), but again was the same, within 0·02, at both temperatures. Another point of interest was the value of the ratio of tensile strength to Brinell hardness number at +20 deg. and —78 deg. Cent. The average values (for tensile strength in tons per square inch) were 0·215 and 0·220, showing that very nearly the same relationship holds for tests at —78 deg. as at room temperature.

For the specimens with a circumferential V-notch, the endurance curves at the two temperatures were, with few exceptions, almost identical. In the exceptional cases (all in the higher alloy range) the endurance limit of the notched specimen was only 1½ to 2½ tons per square inch higher at the lower temperature. The ratio of endurance limit of the unnotched to that of the notched specimens was, on the average, about 3·0 for the wrought steels and about 2·0 for the castings. It was highest (4 to 5) for alloy steels in the condition of highest tensile strength. By comparison of the endurance curves, it was shown that this ratio (the notch coefficient) increased with the number of reversals. For static tensile tests it was about 0·8 and it increased to a maximum value of 2·5 to 4·5 according to the material and its tensile strength. Owing to the fact that the rise (if any) in endurance limit of the notched specimen at —78 deg. Cent. was relatively less than that of the unnotched specimen, the notched coefficient tended to increase at the low temperature, but the increase was small, about 6 per cent on an average.

The general trend of Pomp and Hempel's results may be expressed in the statement that (1) the ratio of fatigue limit to tensile strength at 20 and —78 deg. Cent. is constant for a given steel; and (2) the ratio of endurance limit of unnotched to that of notched specimens at a given temperature increases with an increasing number of stress reversals and suffers a further increase by lowering the temperature. This further increase is small at —78 deg. Cent., but according to Hempel and Luce[2] may be considerably greater at liquid air temperatures.

[1] "The Properties of Metallic Materials at Low Temperatures," London: Chapman and Hall, Ltd. Pages 77–78.
[2] *Mitt. K.W.Inst.Eisenforschung.* 1941, Vol. 23, page 53.
[3] *Proc. Am. Soc. Testing Materials*, 1935, Vol. 35, page 147.
[4] *Archiv für das Eisenhüttenwesen*, 1950, Vol. 21, page 53.

A CEMENT ECONOMY MEMORANDUM.—Although supplies of cement are increasing, the demand outstrips the supply, and an economy memorandum which has been issued by the Ministry of Works is based on the report of the Committee on Cement Economy, on which were represented all sides of the building industry. By following the recommendations contained in the appendix to this report not more than 6 tons to 7½ tons of cement (apart from prefabricated items, e.g., concrete tiles) need be used for building a normal brick house of 1000 square feet gross.

American Engineering News

(By our own Correspondent)

Tender for Seattle Substation Transformers

The Seattle City Light Company, which caused an international controversy earlier this year when it rejected a lower British tender for three large transformers as not meeting specifications and awarded the contract to an American firm, is inviting tenders for a new contract involving six 40,000kW transformers, estimated to cost 200,000 dollars. The new specifications contain no bar against foreign tenders but stipulate that the equipment must have American standard threads and bushings which are interchangeable with those made by the General Electric Company.

Aircraft Industry Developments

The likelihood of both the British de Havilland "Comet" and the Canadian A. V. Roe "Jetliner" becoming available for regular passenger service in 1952, coupled with the fact that American manufacturers, at present, have not a single jet passenger transport aircraft developed beyond the drawing board or model stage, has caused the introduction of a number of subsidy bills, of which one, calling for a 12,500,000 dollar appropriation to finance the testing of experimental jet-propelled transport aeroplanes, is likely to be passed during the current session of Congress. To date, the Boeing Airplane Company is the only manufacturer which has officially announced development work on a pure-jet transport aircraft. The company has ready for wind tunnel testing a model of a four-jet-engined, sixty-passenger transport, designed for a 3000 mile range and a speed of 560 m.p.h. The design has the same swept-back wings which have proved successful on the B-47 "Stratojet" bomber now in production at the Seattle works of the company. The Lockheed Aircraft Corporation has a 225,000,000 dollar backlog of military orders for the production of the jet-propelled F-94 fighter, which is equipped with search radar in its ball-like plastic nose enabling it to detect enemy aircraft approaching through thick clouds and in darkness. For civil purposes, the company is developing a "Constellation" aircraft using propeller-turbine power. The first American turbine-powered commercial transport is scheduled to fly in August, when a Consolidated Vultee "Convair-Liner," with its two engines modified to use General Motors Allison turbo-prop engines, will operate as a cargo carrier. Similar plans are being made by the Douglas Aircraft Company which intends to modify its "DC-6" transport to propeller-turbine power.

Liquid Fuel Products from Coal

Major construction work has been completed by the Bureau of Mines on a synthetic petroleum plant at Louisiana, Missouri. It makes use of a modification of the German Fischer-Tropsch process and will have an output of eighty to a hundred barrels of 75-octane petrol and other oil products per day. This pilot plant was built in order to translate laboratory data into practical cost and design information, enabling industry to plan commercial plants having outputs in the region of 5000 barrels per day. The plant will convert pulverised coal into gas with the aid of oxygen and superheated steam. The gas, a mixture of hydrogen and carbon monoxide, will pass over a catalyst, which will convert it into liquid fuels. According to the Bureau of Mines the process can produce a good grade of petrol, excellent diesel fuel and such by-products as alcohol, wax, alipathic acids and hydrocarbon gases.

Cable Tightening on the George Washington Bridge

Tightening of cables, for the first time since its completion nineteen years ago, has begun on the George Washington suspension bridge between Manhattan and Fort Lee, New Jersey. The project involves the heavy steel collars which are bolted around the four 36in main cables at intervals of 60ft to carry the vertical 3in suspender cables. Each collar consists of two split halves, which are bolted together by from four to twenty bolts. Altogether this maintenance project will cost 120,000 dollars and will take until September, and, after an interruption for the autumn and winter months, until the summer of 1951. The contractor is required to measure the length of each bolt involved under present tension. The nut is then loosened and the bolt measured once more. Finally, the system is tightened to a tension of 100,000 lb and measured a third time. Early results have already shown slight variations in the tensions of the bolts, probably due to a redistribution of load on the bridge span. Two aluminium cages have been specially designed to carry the workmen. The cages ride along the cables on four rubber-shoed rollers and are hauled up by winches mounted at the top of the 600ft high towers. Safety belts and nets slung below the cages are used as guards against falls.

Large-Scale Production of Gas Turbines

The General Electric Company, of Schenectady, New York, has announced that it has commenced large-scale production of gas turbines. The company at present has orders for more than twenty power units, to be used for power generation and pipe-line pumping purposes. Maximum production of the turbines is expected to be reached within eight months when renovation of manufacturing facilities will have been completed.

Typical of the power units to be manufactured is a 3500kW turbine now in operation within the generating system of the Oklahoma Gas and Electric Company and using natural gas as fuel. The installation is based on a simple open cycle and consists of a single axial-flow compressor connected directly to a two-stage turbine which drives a generator through a reduction gear. No regenerators, intercoolers or reheat units are employed. The unit has an overall thermal efficiency to the generator terminals of approximately 16 per cent, based on the lower calorific value of the fuel. Due to the fact that the compressor operates at constant speed regardless of the load on the generator, the part-load efficiency of this unit is relatively poor. Water consumption is at the rate of about 320 gallons per minute for the lubricating oil and generator air coolers. Currently, this type of power plant costs approximately 164 dollars per kilowatt.

Another kind of power unit of 5000kW capacity is about to be installed as part of a hydro-electric power system in New England. It will operate as a base-load unit during periods of low water and as a peaking unit during periods of high water. This gas turbine is based on the open compound cycle and is a two-shaft unit, consisting of a variable-speed low-pressure compressor and a single-stage low-pressure turbine on one shaft and a high-pressure compressor and a two-stage turbine on another shaft, which also drives the generator through a reduction gear. There is no reheating, but intercoolers are used between the low and high-pressure compressors and exhaust heat is recovered by heating the air leaving the high-pressure compressors in regenerators. This unit is anticipated to have an overall thermal efficiency to the generator terminals of approximately 28 per cent, based on the lower calorific value of the fuel. Good part-load efficiencies are obtained on account of the speed of the low-pressure unit varying with the generator load. Total water consumption of the unit is about 1100 gallons per minute. Generating plants employing this gas turbine are expected to cost about 240 dollars per kilowatt.

Presidential Nominations of Engineering Institutions

Mr. Gail A. Hathaway, Special Assistant in the field of water resource development to the Chief of Engineers, Department of the Army, of Washington, D.C., has been nominated to the presidency of the American Society of Civil Engineers for the coming year. Mr. J. Calvin Brown, a mechanical engineer and patent lawyer, of Los Angeles, California, has been nominated for the office of President of the American Society of Mechanical Engineers for the year 1950–51. Mr. T. G. LeClair, chief electrical engineer of the Commonwealth Edison Company, of Chicago, Illinois, is the new President of the American Institute of Electrical Engineers.

Report of the Atomic Energy Commission

The eighth semi-annual report of the Atomic Energy Commission has been submitted to the Congress of the United States. It contains a comprehensive account of measures for the control of radiation hazards and also covers the main features of current American atomic energy programmes. According to the report, production operations relating to atomic energy projects from January to June, 1950, proceeded at the highest rate in the history of the project. Production of both uranium 235 and plutonium was at a rate exceeding that of the previous year. This was brought about without an increase in the cost of operations, and, in fact, these materials were produced during the last six months at the lowest unit costs yet attained. Domestic production of uranium has continued to increase, and plans have been made for the further expansion of operations on the Colorado Plateau. The deposit of primary uranium ores in the Sunshine Mine in Idaho, discovered in 1949, is being explored further. Plans are also being made by the Jones and Laughlin Ore Company to prospect the pitchblende deposit, which was discovered on the Upper Michigan peninsula late last year.

With regard to nuclear power reactors, construction has started at the Reactor Testing Station in Idaho on the building to contain the "experimental breeder reactor" (E.B.R.), the first major reactor in the high neutron energy range. It is scheduled to be completed in 1951 and to cost approximately 3,300,000 dollars. This breeder reactor is designed to test the possibility of creating fissionable material at a rate greater than that at which the reactor consumes it. This means that non-fissionable uranium 238 would be converted into fissionable plutonium faster than the fissionable uranium 235 or plutonium are consumed. Thus, for each pound of U-235 or plutonium used up more than a pound of U-238 would be converted into plutonium.

Another reactor to be constructed at the Idaho station is a "materials testing reactor" (M.T.R.) to operate with slow, thermal neutrons. This will provide a means of testing materials under a neutron bombardment more intense than that produced by any other known reactors. A "submarine thermal reactor" (S.T.R.), the first designed for power and for military use, is being constructed as a land-based prototype at the Idaho site. The Commission has also approved a project of the Oak Ridge National Laboratory for research and development of a low-power homogeneous reactor, in which the fuel and the moderator for the neutrons will not be separate, but will be contained in a homogenous mixture.

A Compact Radiation Detector

A compact radiation meter the size of a wrist watch, which requires no batteries and can be manufactured for less than 10 dollars, is being tested by the Atomic Energy Commission. The new instrument was designed by Drs. Charles and Thomas Lauritsen, of the Radiation Laboratory of the California Institute of Technology, Pasadena. Its essential component is a low-capacity electrostatic voltmeter mounted in a case, which serves as an ionisation chamber. The device is charged with static electricity by turning a small winding stem, which rubs a small hard rubber drum against a leather friction pad. The static electricity causes an aluminium indicating needle to be repelled by a fixed post of opposite charge. As the case is exposed to radiation, the repelling charge is dissipated and the indicator needle, mounted on a spiral spring, moves along a graduated scale. It is claimed that within a minute the amount of radiation present in contaminated areas can be determined. When one radiation determination has been made the operator recharges the meter by turning the winding stem, thus preparing the instrument for the next measurement.

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PRINTING RETURNS TO NORMAL

LAST Tuesday it was announced that the London Master Printers' Association and the London Society of Compositors had agreed to end those conditions that have so seriously affected the printing of this and many other trade, technical and other journals for the last two weeks. The compositors returned to work last Wednesday. But that was a date too late to allow us to make this a full-size issue. Our next issue, that of September 22nd, will be normal in size and since, under the settlement reached, the ban on overtime work amongst compositors that has been in operation since last May will be removed, we hope thereafter to be able to produce issues rather larger than have appeared during the last few months.

It only remains for us to congratulate the Master Printers and the Society on reaching the very sensible decision to conduct negotiations on the original matters in dispute (the present settlement does not affect them) in a more peaceful atmosphere. For the situation that has existed since the end of August only did harm to their interests as well as to the interests of many others.

RAILWAY CONSTRUCTION AND OPERATION

THE practice of railway construction and operation admits of no finality. The Ministry of Transport Blue Book of 1950, setting forth the requirements for passenger lines and the recommendations for goods lines, for new works, reconstructions or alterations, runs to thirty-eight pages. No more than a preliminary glance through certain sections, notably those dealing with signalling, is enough to show that certain features, which in comparatively recent years have been the subject of experiment, if not to say controversy among railway engineers and operating men, have now been resolved sufficiently for precise requirements to be set forth in the 1950 Blue Book. But though controversy may have arisen in the past, and will undoubtedly do so in the future, successive sections of the "Requirements" have been gradually hammered out by the joint efforts of Government Inspectors, railway engineers and traffic officers, and not least the various railway contractors, particularly where signalling is concerned. In the early formative days the counsel and guidance of the Inspecting Officers of the Board of Trade, in the detached and impartial view they could take, played no small part in the building up of the great traditions of safety now inherent in the British railway system. It was the more successful because it was counsel and guidance, and not a series of peremptory orders. Sympathy and understanding of railway problems was shown, from the very first time "requirements" were collated and set down in writing. We have recently had the opportunity of examining this latter document, a two-page memorandum, and the spirit in which it was sent to the railway companies is clear from the covering letter over the signature of Captain Douglas Galton, an engineer who was himself to contribute notably to the advancement of railway engineering science in the famous Galton-Westinghouse brake trials in 1879. His letter to the railway companies, dated April 29, 1858, reads: "Several cases have recently occurred in which the opening of New Lines of Railway has been postponed because certain of the requirements of the Inspecting Officer had not been completed. In order to prevent, as far as possible, the disappointment which such postponement must occasion to the Companies, The Lords of the Committee of Privy Council for Trade have considered it desirable to forward the accompanying statement, which sets forth some of these requirements, a deficiency in which has generally caused the opening of new lines of Railway to be postponed."

Two of the 1858 requirements stand out, as showing the embryo stage to which railway operating safeguards had then progressed nearly 30 years after the opening of the Liverpool and Manchester Railway. First of all, facing points were as good as prohibited: "except on single lines or at double junctions. In the case of facing points at junctions it is most desirable that the signals should be connected with the points so as to be worked in conjunction with them, and to indicate whether they are open or shut." In retrospect, this may seem a most restrictive clause, but actually it was generally in accordance with railwaymen's views at the time; the same views could not have been more strongly expressed when, in 1874, a signalling paper was read and discussed at the Institution of Civil Engineers, and a man of the standing of T. E. Harrison, Chief Engineer of the North-Eastern Railway, said: "I have so great a horror of facing points, knowing the accidents occurring at them, that on the line between York and Berwick for many years, except at the stations of Darlington and Newcastle, there were only three facing points in a distance of 160 miles." Interlocking between signal and point levers was not requested for new works until 1859, and the safeguarding of single-line working was confined to an assurance from the railway management. "Where the lines are single, an undertaking will require to be signed by the Chairman and Secretary of the Company that the line shall be worked in such a manner that only one engine in steam, or two or more when coupled together and forming part of a train, shall ever be upon the single line, or upon defined portions thereof at one and the same time." From these early days the whole practice of railway operating has gradually evolved, to include such fundamentals as block working, facing point locks, automatic continuous brakes, with the more recent and invaluable adjuncts of track circuiting, interlocking block, and automatic train control.

The Blue Book of 1950 embodies as "requirements" certain hitherto-controversial points in signalling that have been resolved as a result of railway nationalisation, though it is made clear that certain relaxations may be made at the discretion of the Minister of Transport in the interests of economy, though, of course, with due regard to safety in operation. Among points which we have particularly noted are the standardisation of the upper quadrant type of semaphore signal, and the use, in colour light areas, of the position light type for shunting with one red and one white light displayed horizontally to indicate stop. The use of a "red," as opposed to two white lights displayed horizontally for stop, was at one time a highly controversial point. The art of route indicating, whether at fast-running junctions or in the approach to stations, has been worked out to logical and efficient solutions in the requirement of a position-light junction indicator in the former instance, while allowing latitude in the design of apparatus for slow-speed applications, where the sighting distance is not long. So far as automatic train control is concerned, equipment of the train-stop type is now a definite requirement for urban electric railways in tunnel and on surface extensions, while "an approved form of equipment of warning type for distant and multi-aspect signals is desirable on important main lines." Altogether, the new Blue Book forms a useful and comprehensive symposium of British railway operating practice.

B.E.A. Power Stations at Oldham and Bold

THE British Electricity Authority has received the consent of the Minister of Fuel and Power to the development of the new Chadderton power station, Oldham, Lancashire, to its full capacity. Authorisation was given last January to the establishment of this station and the installation of a 60,000kW turbo-alternator, two boilers each of an evaporative capacity of 360,000 lb per hour, and a cooling tower. The new consent covers the installation of three further 60,000kW sets, six 360,000 lb per hour boilers and three cooling towers. The total installed capacity of this station, upon which construction work has already begun, will thus be 240,000kW. Consent of the Ministry of Fuel and Power has also been given to the construction of the second half of the new power station at Bold, near St. Helens, Lancs. The authorisation covers two turbo-alternator sets each 30,000kW, two boilers each of an evaporative capacity of 300,000 lb per hour and one cooling tower. Official consent to the establishment of the station and the installation of the first section was given last May. The station will have a total installed capacity of 120,000kW.

Literature

The Principles of Electromagnetism. By E. B. MOULLIN. Second edition. London: Oxford University Press, Amen House, Warwick Square, E.C.4. Price 20s.

THE first edition of this book was written when the author was at the Engineering Laboratory, Oxford, and was published in 1932. It was reviewed in our issue of March 3, 1933. The author is now Professor of Electrical Engineering at the University of Cambridge. The second edition contains an addition to the first in the form of an appendix which is an extension of one of the chapters. The author states in the preface that, through force of circumstances, he has had to abandon his intention of writing companion volumes on the "Principle of the Direct Current Dynamo" and other subjects, for which this book was originally intended as a preliminary. It must now continue to stand alone as a textbook on fundamental principles with practical applications indicated, but not exemplified. It is, however, far more than an introduction to the dynamo—as will be seen from its contents—and thoroughly justifies the modest claim that it is "a fairly comprehensive work on the Principles of Electromagnetism."

The first two chapters, entitled "Elements of Magnetism" and "Second Law of Electrodynamics," include magnetism, magnetic field, force on a conductor, self inductance, induced e.m.f. and eddy currents. They occupy about a third of the book and form the elementary part. The subject matter is treated from an engineering viewpoint and a number of interesting applications are considered. The subject of "Iron in a Magnetic Field" follows and is dealt with in a chapter divided into two parts. The second part amplifies the first and introduces additional problems, mainly having application to dynamos.

Chapters IV and V, entitled "Equations of Electromagnetism and some special problems" and "Maxwell's Equations and the Electromagnetic Field" form the advanced part of the book and occupy about a third. In these two chapters the fundamental laws are expressed mathematically. The operators *div*, *grad* and *curl* are introduced and given a physical explanation. Vector notation is used, but as an addition and not in substitution for the writing of the equations in full. Chapter IV includes the solution of Laplace's equation applied to problems of iron cylinders and spheres in magnetic fields. This gives the theory underlying magnetic screening. The concept of vector potential is explained and applied to problems of current carrying conductors near iron surfaces. In chapter V, after an explanation of Maxwell's equations, Lorentz retarded potentials are introduced and used to find the field due to a current element and to a circular current. Radiation resistance and the strength of the radiation field are determined, thus providing the fundamental theory of radio communication.

It is to the last section of chapter IV on "Skin Effect" that the new appendix is chiefly an extension. Considered together they treat problems of eddy currents in plates and round rods. The former is dealt with fully and rigidly, first of all for an infinite plane and secondly, in the appendix, for a plate of finite thickness. For the latter Bessel Functions are avoided by neglecting the field due to the eddy currents, but the justification for the approximate treatment is very carefully considered. The appendix deals in addition with two other subjects: the effect of the internal field on self-inductance and a discussion on dielectric loss. It is doubtful whether "analysis of the slab problem"—conductor in a dielectric—is appropriate to the book as the author claims, but it contains interesting ideas and an approach to a problem that will be new to many.

There will be some disagreement with Professor Moullin's contention that B and H are quantities of the same character, and "until forces are considered in materials which necessarily contain scattered elementary magnets, there is no reason to distinguish between B and H." Thus the equations on pages 35 and 66 are written :—

$$F = Hil \quad . \quad . \quad . \quad . \quad (16)$$
$$E = Hlv \quad . \quad . \quad . \quad . \quad (4)$$

Modern practice is to write B for H in both these equations. The former equation follows from the definition of B adopted by the I.E.C. in 1933. It is topical to recall that Heaviside always regarded B and H as distinct physical entities* but there has been considerable controversy on this subject. It is very much associated with the system of electrical units. In the M.K.S. system, with $\mu_0 = 10^{-7}$, the difference between B and H is brought out. It is disappointing to find that the author in the 1950 edition of his book has made no reference to the M.K.S. system or to the rationalisation of electrical units.

Although the book has not been revised for the second edition opportunity has been taken to correct a number of small errors that appeared in the 1932 publication. A few, however, have been repeated. On page 71, in equation (9), the coefficient of cos θ in the numerator should be $\frac{b^3 - c^3}{bc^2}$; on page 208 the factor $\frac{\mu - 1}{\mu + 1}$ has been omitted from equation (12); on page 225, the last term of equation (30) should be $\left(1 - \frac{2}{\mu}\right)\frac{i^2}{a}$.

As the author says the average student will not regard it as an easy book. It contains a considerable amount of mathematical analysis. Some of it is rather laborious; occasionally, the results could have been obtained more simply and elegantly. Mathematics is regarded very much as the servant and used to draw conclusions as to physical behaviour and to obtain practical results. There is throughout an engineering approach with numerical values substituted and approximations made—but always explained and justified.

Professor Moullin has used his book for teaching Engineering Courses at Oxford and Cambridge for a number of years. It is, therefore, the advanced electrical engineering student—pre-graduate and post-graduate—who will find it of greatest value and appreciate the examples, with answers, at the end of the chapters. The engineer who does not wish to delve too deeply into the subject, but is interested in fundamental principles, will find—particularly in the earlier part—the principles of electromagnetism explained and demonstrated simply and clearly, but no less precisely, in an interesting and-out-of-the-ordinary manner. For those concerned with the more advanced aspect, methods and ideas are presented and practical results hewn from intricate analysis of problems not covered in the average textbook. The addendum to the second edition enhances the value of the book in this respect.

* See Willis Jackson's paper read at the I.E.E. Heaviside Centenary Meeting, May 18, 1950.

The Rolling of Metals. Volume I. By L. R. UNDERWOOD. London: Chapman and Hall, Ltd., 37, Essex Street, W.C. 2. Price 42s.

THE literature on the rolling of metals contains few attempts to treat the mechanics of rolling as a unified whole, and it is with pleasure, therefore, that one receives a book on the subject from such a well-known authority as Dr. Underwood. The field that can be justifiably included within the title of this book is extensive, and Dr. Underwood has restricted himself solely to the rolling of flat products. The rolling of bars and other shapes is not considered, nor are the design and constructional details of the mills.

The substance of the book first appeared in the form of a report to the Rolling Mill Research Sub-Committee of the former Iron and Steel Industrial Research Council, and later as a series of articles which appeared in *Sheet Metal Industries*.

The book will ultimately be presented in two volumes. Volume I, which is dealt with here, covers the more fundamental aspects of the subject, including the friction between the rolls and the rolled material, forward slip, and the separating force between the rolls, or rolling load as it is often called. After introductory chapters, the hypothetical, but simple, case of homogeneous deformation, uniform pressure distribution and constant coefficient of friction over the arc of contact is considered in order to illustrate the forces acting in the roll gap. This leads from a study of the neutral point or zone to a consideration in chapter 3 of forward slip, and its value as an indication of the frictional conditions present in the roll gap. It might, perhaps, have been preferable for this chapter to have been placed closer to chapter 6, which deals with the friction between the rolls and the rolled material.

A knowledge of the strength properties of the rolled material is essential before any attempt can be made to assess the forces required to deform it, and chapters 4 and 5 are devoted to the study of the flow of the material in the roll gap, the condition of plasticity and the determination of the yield stress curve. The frictional conditions between the rolls and the rolled material are discussed in chapter 6, and the roll separating force in chapters 7 to 10. The theories up to and including that of Orowan, put forward to explain the mechanics of the process and for the calculation of the rolling load, are discussed exhaustively and their relative merits compared. The application of tension and its effect on roll force, Hitchcock's method of allowing for roll flattening and the variation of roll pressure, both laterally and longitudinally in the roll gap, are included in these chapters.

This book, which is very well produced and the printing and diagrams easy and clear to read, will be useful to both the mill designer and operator, and should be an excellent textbook for the student of the rolling process. A comprehensive classified bibliography is included.

One looks forward to the appearance of Volume II, which will deal with the torque necessary to turn the rolls, the energy consumed in rolling and the application of theory to practical rolling problems.

Modern Works Management. By G. SAMUEL MASON, B.Sc., M.I.Chem.E. London: Sir Isaac Pitman and Sons, Ltd. 39-41, Parker Street, Kingsway, W.C.2. Price 15s.

THIS book clearly sets out the general principles of management, treating it as a definite profession in itself, and for this reason it is not confined to any specialised industry, being essentially applicable to any business organisation. It is suggestive in character, and the subject is treated in a broad way, thus making it specially useful to the engineering student who wishes to grasp the fundamentals of sound management. The author points out how changing circumstances necessitate a degree of flexibility and periodic adjustment, particularly now that the Government is taking a greater interest in production. The young manager who is anxious to increase his knowledge of his job will find much to interest him, for the whole matter is treated in a logical and practical manner and is easy to read and follow.

After setting out the general principles of management, the author proceeds to examine how raw material should be controlled, introducing the buyer and his responsible duties, and describing efficient storekeeping (Chapter II). The following chapters are devoted respectively to the control of labour, of workmanship, of cost, and of administration (Chapters III to VI) while the final chapter (VII) gives us the author's personal reflections as to present conditions, followed by a peep into what the future may hold in store. Such is a brief outline of the contents of the work before us.

The subject of quality control is rightly given a degree of prominence, for a good deal has been done in recent years to produce a better and more scientific control, but in this country, much remains to be done, and careful study on the part of managers generally is highly desirable. Who should be responsible for final inspection is not clearly indicated and too often it is found that the chief inspector is placed under the official responsible for actual production—an invidious position. The "family tree," setting out the different branches of the organisation under the managing director is helpful in showing the general staff lay-out, but we cannot fail to notice a number of omissions, e.g., the estimating department, the rate-fixing branch, and the final inspection, which are of paramount importance in a well-run modern factory. Sometimes the estimator is placed under the cost accountant, whereas these two functions should be regarded as opposite numbers, a good cost accounting system being of incalculable value to the estimator, not only in helping him to prepare a sound estimate, but afterwards as a useful check on his estimate, indeed occasional "inquests" on the discrepancies between estimate and actual costs tend to keep everyone on the alert. In a modern factory, there is a growing tendency to resort to functional management, and unless the works manager is vitally alive to the necessity for clearly indicating at the very outset, the relative responsibilities of different functions a state of frustration can readily be engendered, particularly in the minds of foremen and direct operators, a state which it is not easy to eradicate. It is suggested that when any new system is about to be introduced, the manager should hold a meeting to which he calls all those who are concerned, and then clearly explains the position and the respective duties of each branch.

We should like to know what method Mr. Mason would suggest for the recovery of overhead costs, and whether he could apply the machine-hour rate to his general factory, or if he only considers it suitable for an engineering works. We feel he is right in placing the cost accountant under the works manager, as costing should be his servant and not his master, but it is essential that the financial account and the cost account should be interlocked; this however, is outside the control of the works manager.

If a close perusal of an interesting book brings to light a number of apparent omissions, it in no way detracts from its value, but it does perhaps emphasise the desirability of the inclusion at the end of each chapter the names of suitable books dealing with each particular branch more comprehensively than is possible in a general work, thereby enabling the manager or the student to pursue the theme further on right lines; this might well be considered when further editions are in hand. The seasoned manager will find much that is suggestive in "Modern Works Management," which can also be recommended to the prospective works manager and the engineering student, enabling them as it does to approach a subject of growing importance in a sensible and orderly way, and one adaptable to industry generally. We agree with Mr. Parrish in his foreword, when he claims that Mr. Mason's "wide knowledge and experience . . . . must prove of great utility to all engaged in works management."

An Introduction to Heat Transfer. By M. FISHENDEN and O. A. SAUNDERS. London Oxford University Press, Amen House, Warwick Square, E.C.4. Price 15s.

THERE has long been a need for a concise elementary text book on the theory of heat transfer available at a reasonable price. This need has now been met by Dr. Margaret Fishenden and Professor O. A. Saunders in their new book, where, in a space of about 200 pages, they introduce the reader to the various aspects of the subject which are of interest to engineers. The book will be welcomed by students and by those in industry who have problems in heat transfer and are concerned with the design of heat exchangers. They will find in it a clear statement and explanation of the fundamental equations free from irrelevant mathematics. Its chief advantage over other books on heat transfer is that the authors have taken great care to go over the vast amount of published experimental data, and to refer only to work of general practical interest whose accuracy is well established.

The first chapter deals with radiation and includes a useful summary of Hottel's work on radiation from water vapour and carbon dioxide and of various measurements of radiation from luminous flames. The second chapter deals with conduction and the next four with various aspects of convection. A clear introduction is given to the difficult problem of the relation between heat transfer and friction. The subject of natural convection is dealt with very thoroughly, including convection through fluid layers between two parallel plane surfaces. The information on forced convection in streamline flow through pipes is well summarised but it appears that there is still no satisfactory method of dealing with the important transitional region at Reynolds Numbers of 2000 to 10,000. The authors have collected together the results of several experimenters on heat transfer and pressure drop in flow across tube banks. These results are expressed in a very useful table for different Reynolds Numbers and for all the standard arrangements of tubes; it would probably have been more convenient, however, if the friction factor had been expressed as a fraction of the velocity head lost per row of tubes, rather than as a dimensional constant.

The last two chapters deal with heat transfer from condensing vapours and to boiling liquids. In any book on applied heat transfer, the chapter on boiling is inevitably the weakest, since few attempts have been made to extend the many laboratory measurements of heat transfer to liquids boiling on submerged surfaces, to industrial multi-tube boilers; this is due to the difficulty of preventing scale formation and of making sufficiently accurate plant measurements to enable such high heat transfer coefficients to be determined. The authors have faithfully described the laboratory experiments and have included useful correlations of the maximum heat flux and the corresponding temperature difference, with the ratio of the pressure to the critical pressure. It is a pity that only the last page of the book is devoted to the very important subject of natural circulation evaporators. Although no theoretical explanation is yet available for the various results of Badger and his fellow workers, they are, nevertheless, of sufficient value to deserve a more detailed account.

The engineer who uses this book for industrial calculations will find his task simplified by the numerous worked examples, simple but to the point, and by the charts and tables giving the properties of the more common fluids and the emissivity of various surfaces.

High Polymeric Chemistry. By W. S. PENN. London: Chapman and Hall, Ltd. 37, Essex Street, W.C.2. Price 36s.

THIS book deals with the chemistry and structure of high polymers which may be defined as substances of high molecular weight formed through the medium of primary valency linkages from similar molecules of relatively low molecular weight. Accordingly, it is concerned mainly with the highly specialised branch of organic chemistry which is the foundation of the plastics and rubber industries. These industries involve the application of highly skilled engineering and chemistry. For this reason, most of the books hitherto published in this sphere have attempted to combine in one volume an outline of high polymeric chemistry side by side with a review of the machinery and plant used in producing the plastic substances. The author of the present work has confined himself to the chemical side only and he has produced a comprehensive treatise on the subject. What is of equal importance is that the book contains numerous references to other published work in the same branch of chemistry, while it is also very well indexed. Mr. Penn divides his work into sixteen chapters and concludes with a lengthy appendix on low-temperature polymerisation. The first part of the book is devoted to a description of the formation of large molecules, their structure and properties. This is followed by a description of the modern methods employed in the examination of high polymers. Subjects which are likely to be of direct interest to engineers are the methods for X-ray examination of the different materials, and the use of the electron microscope. It has for some years been possible to examine the internal structure of crystals by X-radiation, and materials which have any semblance of ordered internal structure can be investigated in this manner. High polymers, however, are not ideal specimens for X-ray examination, but, as the author points out, by suitable mechanical treatment, such as stretching, rolling, &c., it is possible to orient the molecules of some polymers so that on examination with X-rays, a true crystalline

diagram is obtained. A good description of the theory and use of the electron microscope is given. Possibly this section of the book offers the only ground for any criticism that can be made of the whole work, for the electron microscope illustrated is an American instrument. There are at least three different electron microscopes made in Britain, and it is likely that British workers would be using the latter, the construction of which differs from the American equipment. The book covers very thoroughly the important subjects of the fractionation of polymers, the structure of vinyl polymers, acenaphthylene, polytetrafluoro-ethylene, polyvinyl-pyrrolidones and synthetic rubbers, &c. It explains the theory of the subject and also how these theories are applied in practical industrial work. These applications are made clearer by the use of a number of excellent photographs taken in different industrial concerns. A big advantage of the book is that it brings together under one cover for the first time practically the whole information available on the subject, and that which is not given in detail is named in the references. In a lengthy volume of this description there is bound to be a time lag between the preparing of the manuscript and the completion of the work, but the references to other published work have been made as up to date as possible. It is primarily a book for the organic chemist and is sure to prove a useful volume for both industrial and academic workers as well as for students. In addition to many excellent photographs, it contains numerous drawings and diagrams and is written in a style that facilitates reading.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

PRIDE IN WORK

SIR,—It is an interesting experience to read at one sitting the valuable article on production methods in the works of Joseph Lucas, Ltd., and your leader on "Pride in Work" in THE ENGINEER for August 18th. How, one asks oneself, can a row of girls sitting by a moving belt, each doing some little job on a unit that is only seen perfected by the last girl in the row, be expected to feel any pride in it? They might, or they may, have mass pride in the shop they work in, or in the firm they work for. But that is a very different thing from the pride that the individual craftsman takes in the product of his hand and skill. The amateur who, in his spare time, makes a clock at the kitchen table may show it to his friends with a pride that is denied to the mass workers in a Swiss or American clock factory. Moreover, the operatives must often feel, if they have any feelings in the matter at all beyond the weight of their pay envelopes, that there is mighty little to be proud of in many mass productions. Who, save the ingenious designer, can feel pride in a cheap alarm clock?

Modern mass production methods demand the obliteration of the individual as completely as the obliteration of the single bee in a hive, or a single ant in a heap. The ant and the hive-bee are known as social insects. I leave the corollary to the reader, lest I be suspected of disrespect to the human species. Is not the fundamental principle of socialism just this and no more; that individuals must give place to the mass?

In a grossly overpopulated world, and a world that has accepted the policy of "full employment," despite its manifest dangers; in a world of which one-tenth of the inhabitants demand more amenities and nine-tenths demand more food; in a world which is seeking to achieve the economic impossibility of living in peace by "taking in each other's washing"—in such a world the battle for existence can only be carried on by intensive production in order to get (*a*) food and (*b*) occupation.

But it is out of the question to expect pride in work—save amongst a few—in a world that is bedevilled by the constant urge to produce ever more and more. Pride in work is an incentive that only the very few may enjoy. True, we may get mass pride, like the mass pride of railwaymen in the old days—now killed by nationalisation after being stunned by rationalisation in 1921. But craft pride is only to be found in solitary workers, the men that do jobs on their own or with but a few helpers—often in the family.

We must not confound interest in work with pride in work. One may be interested in sawing a log or planing a plank, but he must be a very new hand who takes pride in doing so. Thus we may evoke interest in the workers at a belt by explaining to them what the sum of all the operations amounts to and why each worker's share is important; but very soon all that is forgotten and the abiding interest is the pay packet.

Yet I am confident that the desire to do something on one's own and has not yet been slain by the insidious virus of the social creed. Am I wrong in thinking that since the war there has been an increase in the number of independent craftsmen? Happy the householder who finds one, for it is a certainty that he will take a pride in his work. Is it because he feels that responsibility rests on himself alone?—there is no higher authority on whom he can discharge his faults; nor one that can take the praise for his good work. Like the professional man, the doctor or the lawyer, he stands or falls upon his own merits.

Fortunately for the soul of their country, there are far more small factories than great ones: factories that are small enough for each separate worker to feel that he is an essential part of the whole. There perhaps one may find pride in work when those who guide and direct are men of the right mettle. Years ago Priestman's of Hull sought, not unsuccessfully, to simulate the small factory by giving different shops an identity of their own and encouraging emulation between them. Has that plan, too, been slain by the pitiless urgency of the age?

L. P.

London.

SOME AMERICAN LOCOMOTIVES AND THEIR RUNNING

SIR,—The question raised by Mr. Budd about the spectacles worn by American enginemen is interesting and I am sorry that I cannot answer it. I should imagine that if protection of the eyes were the primary object, goggles would be used, whereas my impression is that the men who wear glasses when on a locomotive do so only because it is their normal habit.

W. A. TUPLIN, D.Sc., M.I.Mech.E.

Huddersfield, August 25th.

STIFFNESS OF CRANKSHAFTS OF COMMERCIAL OIL ENGINES

SIR,—I was interested in the article on page 215, August 25th, the more particularly because having spent much time on similar work in the past, I can appreciate how much labour may be involved in developing a crankshaft stiffness formula.

In *Engineering*, September 10, 1937, page 275, I described the development of such a formula and compared it with the Carter formula which was perhaps the most widely known one at that time. The new formula gave somewhat closer agreement with measured stiffness over a range of seventeen crankshafts of widely different designs, and perhaps Mr. J. Smith may be interested to apply it to the examples used in his own work on the subject.

Expressed in the symbols used on page 215, the 1937 formula is:

$$\text{Equivalent length of unit diameter shaft} = \frac{L_j+0\cdot15D_j}{D_j^4\left[1-\left(\frac{d_j}{D_j}\right)^4\right]^2}+\frac{L_c+0\cdot15D_c}{D_c^4\left[1-\left(\frac{d_c}{D_c}\right)^4\right]^2}+\frac{2L_w-0\cdot15(D_j+D_c)}{B^4-d_j^4}+\frac{R_o}{L_wB^3}\left[\frac{0\cdot065D_j}{L_w}+0\cdot58\right]+\frac{0\cdot016}{L_w^2B}.$$

W. A. TUPLIN, D.Sc., M.I.Mech.E.

Huddersfield, August 25th.

SIR,—With reference to the article on "A Provisional Formula for Estimating the Stiffness of Crankshafts" which you published in your issue of the 25th August, I very much regret that there is an error in the third term of the BICERA formula which appears in the right-hand column immediately after reference to Mr. Smith of the National Gas and Oil Engine Company, Ltd. The name of this company is also incorrectly published due to our abbreviation Cp. instead of the more usual Co. The third term should read

$$\frac{0\cdot07\,L_c^3D_c^4}{R_o^2(D_c^4-d_c^4)}.$$

This is entirely our error, we apologise for it, and would be exceedingly grateful if you could issue a correction.

J. WHITE

Information Officer, BICERA

Slough, Bucks, September 4th.

BOOKS RECEIVED

Machining of Copper and its Alloys. Herts: Copper Development Association, Kendals Hall, Radlett.

Schraubenherstellung. By Dr.-Ing. Ernst Lickteig. Dusseldorf: Verlag Stahleisen M.B.H., Dusseldorf. Price D.M. 26.

Extraction of Non-Ferrous Metals. By E. R. Roberts. London: Temple Press, Ltd., Bowling Green Lane, E.C.1. Price 16s.

Acceleration of Particles to High Energies. London: The Institute of Physics, 47, Belgrave Square, S.W.1. Price 10s. 6d.

Thermodynamics. By J. R. Partington. Fourth edition. London: Constable and Co., Ltd., 10, Orange Street, W.C.2. Price 22s. 6d.

Properties of Asphaltic Bitumen. By J. Ph. Pfeiffer. London: Cleaver-Hume Press, Ltd., 42A, South Audley Street, W.1. Price 45s.

Machinery and Manipulation of Stainless Steels. By W. F. Walker. London: Emmott and Co., Ltd., 21, Bedford Street, W.C.2. Price 3s. 6d.

Drop Forging. By Henry Hayes. Second edition. London: Sir Isaac Pitman and Sons, Ltd., Pitman House, Parker Street, Kingsway, W.C.2. Price 6s.

Engineering Drawing and Drawing-Office Practice. By P. S. Houghton. London: Crosby Lockwood and Son, Ltd., 39, Thurloe Street, S.W.7. Price 15s.

Manufacturing Processes: Materials. By S. E. Rusinoff. London: The Technical Press, Ltd., Gloucester Road, Kingston Hill, Surrey. Price 40s.

Manufacturing Processes: Production. By S. E. Rusinoff. London: The Technical Press, Ltd., Gloucester Road, Kingston Hill, Surrey. Price 42s.

Casting of Brass and Bronze. By Daniel R. Hull. U.S.A.: The American Society for Metals, 7301, Euclid Avenue, Cleveland, 3, Ohio. Price 3·50 dollars.

Jig and Fixture Design. By H. W. Hardy. London: Sir Isaac Pitman and Sons, Ltd., Pitman House, Parker Street, Kingsway, W.C.2. Price 12s. 6d.

Workshop Record Book. Prepared by L. J. T. Wheatley. London: Sir Isaac Pitman and Sons, Ltd., Pitman House, Parker Street, Kingsway, W.C.2. Price 5s.

THE S.B.A.C. FLYING DISPLAY AND STATIC EXHIBITION

VICKERS SUPERMARINE "535"

ENGLISH ELECTRIC "CANBERRA"

"HERMES V" AIR LINER

VICKERS SUPERMARINE "SEAGULL"

The S.B.A.C. Flying Display and Static Exhibition

No. II—(*Continued from page 253, Sept. 8th*)

ONCE again at Farnborough the S.B.A.C has proved to the representatives of world aviation that Britain has not only kept abreast of general aerodynamic research but in anticipating the worth of turbo-jet and turbo-prop aircraft propulsion has secured a substantial lead in this new era of civil transport. The performances given by so many different types of aircraft provided a remarkable testimony to the success of the efforts of those in the British Aircraft Industry who have designed, produced and tested these machines.

A notable contest to produce Britain's fastest fighter was revealed by the impressive performances of the Hawker "1081" and the Vickers' Supermarine "535," recalling as they did that notable rivalry between their predecessors of the piston era—the Hurricane and the Spitfire. Both machines were superbly flown and shown to be very manœuvrable at speeds well in excess of 600 m.p.h. These aircraft embody the latest refinements of aerodynamic knowledge. The Supermarine "535" is the latest modification of the Vickers' line of single engine jet fighters and first flew last month. The wing has pronounced sweep back, low aspect ratio and a span which is reputed to be less than the Spitfire. The tail assembly itself, as can be seen from the photograph we reproduce, is swept back to the same angle as the wing and the tailplanes have slight dihedral. An unusual landing technique has been developed, whereby the aircraft takes off on the customary nose and tail wheels but lands with a considerable angle of "attack" on the main wheels and a tail wheel slightly forward of the rudder, finally settling on the nose wheel. This initial landing attitude, together with a specially designed aileron, probably contribute to the very moderate landing speed of this machine. The Hawker "1081" is similar in major respects to the "535" and both aircraft are powered by the Rolls-Royce "Nene" with re-heat installation. The "1081" is a modified version of the earlier "1052," but now has a single tail jet orifice to accommodate the re-heat installation. The tail assembly of the "1081" is fitted with variable incidence tail planes to obviate the use of trimming tabs which cause the tail assembly to stall during certain manœuvres.

Several variants of the ubiquitous Meteor were again demonstrated. The Gloster "Meteor Mark 8" fitted with Rolls-Royce "Avons" of unspecified but considerably more powerful thrust than those fitted last year in this aircraft, and the "Meteor Mark 8" with Armstrong Siddeley "Sapphire" engines which develop 7200 lb thrust, both demonstrated sustained climbs estimated to be at the rate of about 13,000 feet per minute. The demonstration of the Avon Meteor was further distinguished by the performance of high speed outside loops (bunts) and steep horizontal turns with the pilot on the outside, notwithstanding the presence of 1000 lb wing-tip bombs and a large capacity central drop tank.

Two machines designed for high altitude, high speed night interception were demonstrated. They were the de Havilland "Venom Mark II" fitted with one de Havilland "Ghost" turbo-jet with 5000 lb thrust, and the Armstrong Whitworth Mark II, another variant of the "Meteor" fitted with two Rolls-Royce "Derwents."

Another of our illustrations opposite shows the English Electric "Canberra" (two Rolls-Royce "Avons") which is still the only British jet bomber announced. We understand that there are now several different marks of this aircraft. The speed and manœuvrability of this machine when unloaded were shown to be almost equal to that of the jet fighters, and indicate how low the wing loading of this aircraft has been maintained. Moreover, it possesses one of the cleanest aerodynamic lines of any aircraft on display. Both the wings and engine nacelles are fitted without fillets; the wing has no sweep back and has an aspect ratio 4 : 3. The tailplanes are fitted with variable incidence.

The Fairey 17 and the Blackburn Y.A.5 have been produced from the same specification, and are designed to combat submarines fitted with Schnorkel breathing apparatus. For this purpose they both have large retractable radomes and spacious bomb bays. Both these machines are fitted with the Armstrong Siddeley "Double Mamba." This engine, it will be recalled, has two single Mamba engines mounted integrally and driving coaxial propellers, independently. These aircraft are able to cruise with one Mamba operating at its optimum cruising efficiency with the other feathered, unless required for combat or take-off purposes. Another naval aircraft notable for its versatility and technical innovation is the Vickers Supermarine "Seagull." This amphibious aircraft, designed to succeed the familiar "Walrus" and "Sea Otter," has also been equipped to satisfy more exacting naval requirements. The aircraft has a Rolls-Royce "Griffin" engine developing 2500 H.P. driving three-blade contra-rotating propellers which obviate slip stream and reaction torques whilst on the water. It has a top speed of 260 m.p.h. at 12,000ft, an all-up weight of 14,500 lb, and a still air range of 1230 miles. The incidence of the main wing can be adjusted to suit landing, take-off and optimum cruising requirements. Hitherto, with an amphibian aircraft it has never been possible to design an efficient ærofoil to satisfy these widely different attitudes in its flying range, with a fixed "rigging" incidence. The wing is also fitted with interconnected full length leading edge wing slots and large area slotted flaps. As this aircraft has a wing loading of only 33·6 lb per square foot it is expected to have a very low minimum flying speed.

The Vickers "Viscount 700" with four Rolls-Royce "Dart" turbo-props, the Armstrong Whitworth "Apollo" with four "Mamba" turbo-props and the Handley Page "Hermes" Mark V with four Bristol "Theseus" turbo-props gave convincing demonstrations of their speed, manœuvrability and quiet running. All these aircraft have cruising speeds in excess of 300 m.p.h. and each executed steep turns with both engines on one side feathered. The "Viscount" appeared particularly manœuvrable with all its engines except the starboard outer feathered, and the "Hermes V" took off and climbed on three engines at a greater rate than the "Hermes IV" using four "Hercules" piston engines. The "Hermes V" has an all-up weight of 90,000 lb, and is designed to cruise at 340 m.p.h. on Continental air routes at 25,000 ft and has a still air range of 2000 miles. The fitting of Handley Page double-slotted flaps has reduced this machine's landing run to 770 yards and the take-off run to 960 yards. The Vickers "Viscount" can seat 40 passengers for a still air range of 1950 miles and has a fuel consumption of 224 gallons per hour at 25,000ft. At any other altitude this consumption decreases to about 190 gallons per hour when the aircraft is flying with the outboard engines feathered at a speed of 190 knots. It is thus able to operate under the same I.C.A.O. requirements as stipulated for piston engines, by this use of the engines.

(*To be continued*)

Hungarian Five-Year Plan

LAST year, the National Assembly of the Hungarian Republic approved a five-year scheme for the development and modernisation of the industry and agriculture of the country. The cost of the plan is estimated at 50,900 million Forints (about £1550 million). Expenditure is divided amongst several items, of which the most important are industry, 21,300 million; agriculture, 8000 million; transport, 7500 million; building and town planning, 7400 million.

The large sum to be spent on industrial developments includes about 2465 million F., which will be invested in the mining industry, and it is hoped that the output of coal will rise from 11½ million tons in 1949 to 18½ million tons in 1954 as a result of this expenditure. Nearly 4000 million F. will be spent on the iron and steel industry, and the new plants which will be built will include a foundry, open-hearth furnaces, a rolling mill and two blast-furnaces. Steel production will be 1,600,000 tons in 1954, it is estimated, as compared with 890,000 tons in 1949.

According to the plan, the overall production of heavy industries will reach the figure of 7·725 million F. by the end of 1954, i.e., an increase of 138 per cent as compared with 1949. Some examples of the expected increases in production over this period are, in 1954, 4600 tractors, against 2600; 10,000 railcars and wagons, against 4850; 23,000 lorries, against 12,000.

Thermal power plants will be built at Varpalota, Barcika, Mohacs and Loyaszi, and a hydro-electric plant at Tiszalök, thus increasing the production of energy to an estimated 4270 million kWh in 1954, as compared with 2200 million kWh in 1949. The plan also contains provision for the construction of new transmission lines having an overall length of 530 miles. Other industries, such as cement, textiles, chemical, mechanical and electrical, &c., will also be developed.

The Intercontinental Airport, Rome

SOME months before the end of the war the Allies constructed an airport at Ciampino, about 10 miles from Rome, for transport aircraft. After the end of hostilities the airport was handed over to the civilian authorities and eventually became one of the busiest of the Italian airports. Because of its limited possibilities, however, the Italian Air Ministry decided to replace it by a modern intercontinental airport to serve the city of Rome. A special committee, appointed by the Government, selected a site known as "Bonifica di Porto," near Fiumicino, about 14 miles from the capital, for the new airport, which will be provided with six runways, each 7000ft long and 197ft. wide (except one measuring 9840ft by 295ft), and with terminal building, aircraft hangars and other buildings. The airport is designed for a daily traffic of 240 aeroplanes (i.e., 480 landings and departures), and its total cost is estimated at 15,000 million lire (£7·8 million).

THE ST. LUC MARSHALLING YARD, MONTREAL, C.P.R.

FIG. 1—YARD SEEN FROM HUMP

FIG. 2—CLASSIFICATION SWITCHBOARD

FIG. 3—ENGINE HOUSE

FIG. 4—CENTRALISED TRAFFIC CONTROL MACHINE

The St. Luc Marshalling Yard, Montreal, C.P.R.

By EDWARD H. LIVESAY

A WINTRY evening, ten years ago, found me at the C.P.R. Outrement marshalling yard, near Montreal, waiting to board the engine—No. 2800, the first of the fine class of 4–6–4 "Hudsons"—that was to haul a fast freight train, the "Mae West," to Toronto; the ensuing run was described in THE ENGINEER of October 25, 1940. Chatting to an official, I remember mentioning that a few weeks before I had spent a night at a corresponding British marshalling yard, Toton ("A Beyer-Garratt Locomotive Experience," October 3, 1941, THE ENGINEER), and outlined to him the method employed there in assembling freight trains, by means of a hump and retarders. This brought a rejoinder somewhat typical of many heard in N. America: "Well, that's all right with the small trucks you use over there, but it couldn't be worked here with 40-ton box-cars; they have to be pushed into position mostly and hand-controlled by brakemen."

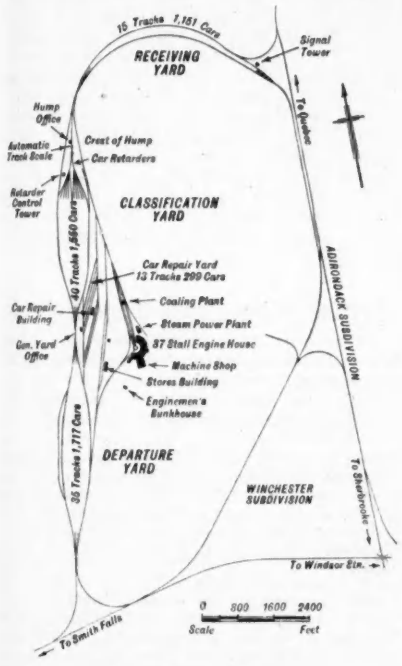


FIG. 5—ST. LUC YARD

Plausible enough but I did not agree with it, though I was too diffident to enter into an argument with an expert. Had I put forward my own views, they would have been in effect that the Canadian method was good enough for a small station siding, no doubt, but was very out of date for a big marshalling yard such as Outrement, where the much more efficient European system was clearly called for. It is evident that similar conclusions have at long last been reached by other and more responsible heads than mine; I merely mention this incident to illustrate the fact that all railway methods in vogue in N. America are not necessarily of an advanced type, but that when this dawns upon the people concerned the arrears are often made up very thoroughly, as the following description of the St. Luc marshalling yard will tend to show. Incidentally, I believe that Toton, too, has had a "face-lifting" recently, and this brings out another difference between methods possible in old and newer countries—one cannot call Montreal exactly "new," after three centuries of growth. In the former, for various reasons, it is not always possible to start "from the ground floor" with an entirely new installation and engineers must often be content to improve upon existing equipment and lay-out; in the latter, where generally more space is available and land values lower, it may be feasible to construct a new system "from scratch" rather than make alterations and additions to an older one, in which case all the latest devices can be embodied, without any consideration save that of maximum efficiency. Such, I should say, has evidently been the case at St. Luc.

This "classification yard," to use Canadian terminology, is claimed to be the most up to date in N. America. Under construction for two and a half years, it involved the dumping of 950,000 cubic yards of filling and 200,000 cubic yards of ballast, and the expenditure of 12,000,000 dollars; it embodies a combination of principles and practice unique in freight yard operation, at least so far as the N. American continent is concerned. Covering 682 acres, it includes 111 tracks, with a total mileage of 75, spread out over a triple series of operational yards, receiving, classification and departure, as will be seen in the plan, Fig. 5. The receiving section has fifteen tracks, with a capacity of 1151 cars; the classification section has forty tracks for 1550 cars, and the departure section thirty-five tracks, with accommodation for 1717 cars. In addition, there are repair and storage facilities and, altogether, the St. Luc yard will make possible quicker and more efficient handling of freight into and out of Montreal, the largest city in Canada, as well as an important industrial centre and seaport. The inauguration of services at the St. Luc yard will enable considerable economies to be effected elsewhere, as three other freight yards will be closed—the sorting yard, just past Montreal West, Hochelaga yard, in the east end, and Outrement yard in northern Montreal. The engine houses in the two latter yards will also be closed, the facilities at St. Luc yard being so much better; they include the steaming-up of locomotives from a stationary plant, with the result that 85 per cent of the smoke from this operation is eliminated, and considerable saving of fuel achieved over the old method—lighting-up the engine from cold.

The entire lay-out of the St. Luc yard is new; it has literally been built from the ground up. Fig. 6 shows a ballast-spreader engaged on the preliminary work of raising the hump. The terminal has a capacity of 4869 cars; trains enter the receiving yard at the north end of the establishment, near Montreal West, coming in off the main line from Smiths Falls, the first divisional point on the route to Toronto. From the receiving yard the trains are pushed up to and over the hump by diesel yard engines, the cars being automatically switched to their designated tracks in the classification section by the foreman seated at the switch-board, Fig. 2 in the control tower, Fig. 7. Just before reaching the hump they pass over an inspection pit, Fig. 8, in which three men are seated, one right between the tracks, as seen in the picture, and one on the outer side of each rail, protected by shatter-proof glass and aided by floodlights. As the cars pass over the hump and pit at approximately 2 m.p.h., the running-gear and undersides are inspected from below, defects noted and the faulty cars tagged; the hump foreman and retarder operator are then notified that the invalids should be directed to the repair yard, the position of which is indicated in Fig. 5.

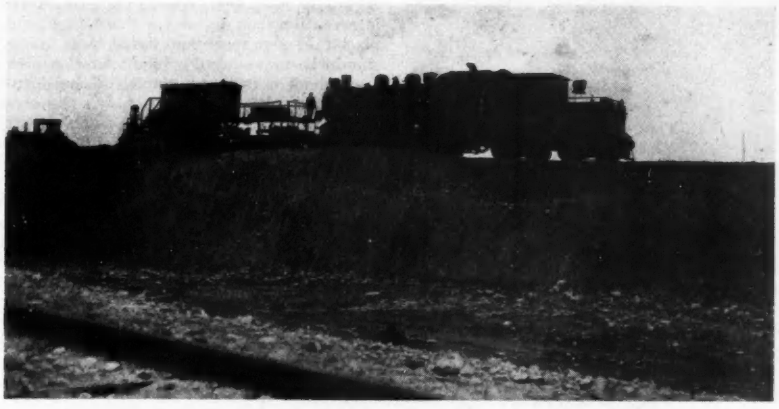


FIG. 6—BUILDING THE HUMP

A general view of the yard from the crest of the hump is seen in Fig. 1, in which cars are shown in motion towards the classification tracks, with the retarder in the foreground, operated from the tower by push-button controls, Fig. 9. Also in the foreground of Fig. 1 is the track weighing scale, with the weigher's office on its left, upon which every car passing through the yard is automatically weighed without stopping.

FIG. 7—CONTROL TOWER

The steaming-up of locomotives in the thirty-seven stall engine shed is done from a stationary plant, fires only being built in engines when they are on their way out to the trains in the departure yard, which largely overcomes the smoke nuisance so prevalent near engine-sheds. Fig. 3 shows the shed and its

110ft three-point-bearing turntable. Except when a quick turn-around is called for, an engine enters the shed with its fire drawn and ashes dumped, this being done at a 400-ton, three-track coaling plant, Fig. 10, which is

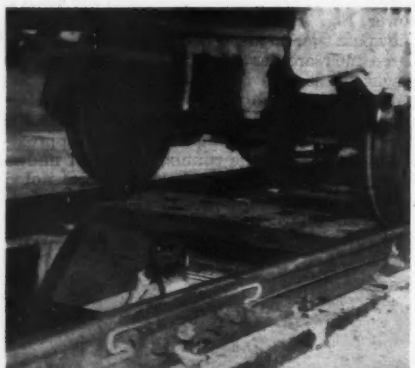


FIG. 8—INSPECTION PIT

equipped with a below-ground-level mechanical chain-pan underfeed cinder conveyor, with hoppers between the metals, into which the cinders are discharged, and from which they are transported to cars for disposal.

Inter-yard communications are by telephone, teletype and loud-speaker, and flood-lighting has been installed for night operations; some of the 100ft towers can be seen in Fig. 1. At peak periods it is anticipated that upwards of 3000 cars will be handled in twenty-four hours, and the saving of time resulting from hump operation is likely to make possible the switching of an eighty-five-car train in twenty minutes. The C.P.R., with the St. Luc yard, is the first company in N. America to adopt the push-button system of marshalling and many of the operational details of this installation are claimed to be quite original. After classification and/or repair, the cars move on an assembly-line basis into the departure yard, where road engines are coupled on and haul the trains out through the southern exit on to the main line, 3½ miles from the northern entrance; all the yard traffic is therefore one-way.

The make-up of trains arriving at the yard is known to the staff almost as soon as they leave their last divisional points; this is achieved by a teletype system recently developed by the International Business Machines Company to C.P.R. specifications. From this information it is decided where a train shall be placed in the receiving yard, how quickly it should be moved and split up for classification, and where it is to be placed in the departure yard, the teletype having shown the contents and destination of each car, and other switching information. As the trains enter the north end of the yard they pass the signal tower, shown on the plan, Fig. 5, from which the operator handles the movement of trains by the centralised traffic control machine, Fig. 4, according to the lights on the track diagram, which indicate their progress and location. On the basis of this information, received in advance, the operator in the signal tower knows where they are to go in the receiving yard, sets the switches and signals accordingly and diverts the trains from the main line. The engine and caboose (van) are then detached and the former directed to the coaling plant and shed; the train is then ready to be pushed to the hump by the diesel shunter, where the cars are cut off according to the predetermined switch-list held by the foreman in the control tower, who operates the power switches of the hump control machine, Fig. 2, and directs the cars into the proper tracks in the classification yard after weighing. The retarder operator, also in the tower, controls the speed of the cars in their descent from the hump by the push-button panel, Fig. 9, which applies the retarders to the car-wheels in the usual way.

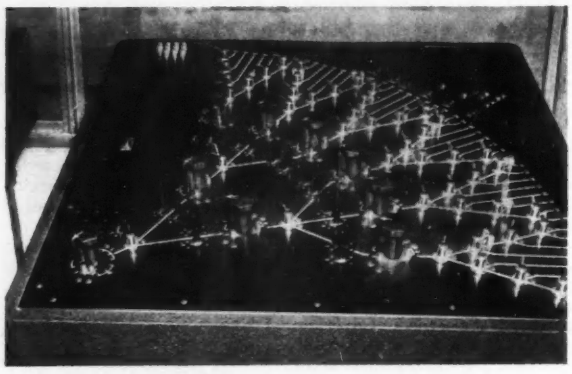


FIG. 9—RETARDER CONTROL SWITCHBOARD

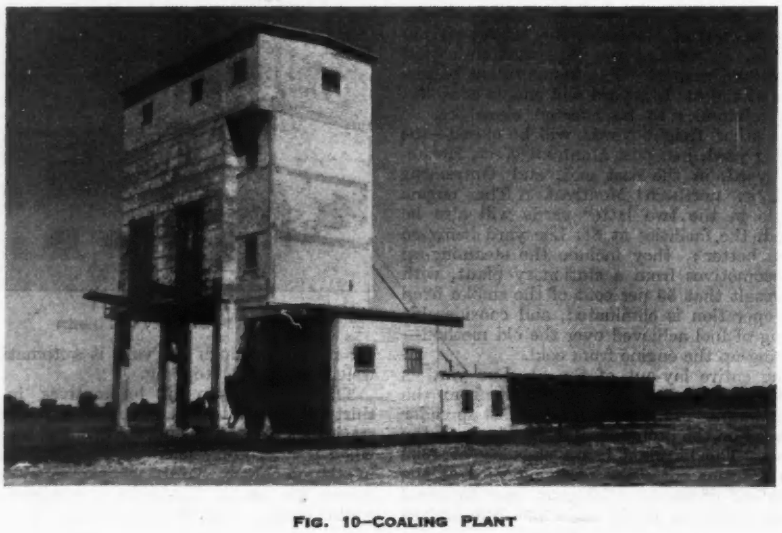


FIG. 10—COALING PLANT

Finally, the cars having been assembled in the proper order in the classification yard, they are then pulled out into the departure yard, the van is added, air-brake pipes connected throughout the train and reservoirs charged from the steam power plant supplying pipes serving each departure track. Meanwhile, the engine assigned to the make-up train comes from the shed on a charge of hot water and steam furnished by the stationary boiler, its fire being built up on the way out. In the event of the train engine being diesel the procedure is correspondingly simplified.

So much for the St. Luc yard, which was officially opened by the Minister of Transport, the Hon. Lionel Chevrier, K.C., on July 6th, when he pulled the coupling-pin releasing box-car No. 240,203 from the train and it passed over the hump, breaking through a silken banner on its way down to the classification yard. I think it will be admitted that this "classification yard" has been admirably planned, built and equipped, and is a credit to the C.P.R. and the engineers responsible for it. I wish St. Luc all the luck in the world. Nevertheless, much of my heart remains at Toton, with its never-to-be-forgotten memories of the roast chicken supper provided at midnight by the fireman of the Beyer-Garratt, when I plaintively urged that my soul was fainting within me after hours and hours crawling through the black-out. I very much doubt whether anyone will be so charitable at St. Luc, if peradventure I should arrive there in a similar condition!

British Standards Institution

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria Street, London, S.W.1.

THERMAL INSULATING MATERIALS, PLASTIC COMPOSITION, FLEXIBLE AND LOOSE FILL

No. 1589 : 1949. This is one of a series of British Standards for thermal insulating materials. As in the case of B.S. 1334, "Pre-Formed Insulating Materials," it applies to central heating and hot and cold water supply installations. Unlike the above Standard, however, it does not specify thickness requirements, as it is considered undesirable for the type of installation work within the scope of the standard to merge two distinct responsibilities, namely: (*a*) the manufacture and delivery in bulk form, and (*b*) the manual operations on site. Recommendations for thickness, however, are given in the appendices, together with information regarding the satisfactory application of the materials. Price 2s. post free.

TWIST DRILLS AND COMBINED DRILL AND COUNTERSINK (CENTRE DRILLS)

No. 328 : 1950. This standard was first published in 1928, and B.S. 985 "Combined Drills and Countersinks," was published in 1941. Both subjects are now combined in the revised edition of B.S. 328. The section dealing with twist drills has been amended and extended, special attention having been given to the nomenclature and definitions of drill parts, as the need has long been apparent. The testing requirements have been brought up to date and the penetration capabilities of the drills modernised and extended. An important function of standardisation is that of reducing the multiplicity of types and in this connection an important innovation in the specification is the emphasis of "preferred sizes" and the quotation of alternatives in the tables covering the drill gauge and letter sizes of twist drills. The section dealing with combined drills and countersinks (centre drills) has been presented in a manner similar to that of twist drills, and a complete range of definitions has been included together with tables giving manufacturing limits of tolerances. The dimensions of self-drive holding tapers are mentioned in an appendix and are quoted from a British Standard which is in course of preparation. Price 6s.

Industrial and Labour Notes

The Trades Union Congress

The eighty - second annual Trades Union Congress was in session at Brighton throughout last week, under the presidency of Mr. H. L. Bullock. On Tuesday, September 5th, the congress was addressed by the Prime Minister, the Right Hon. C. R. Attlee, who said that the wise restraint exercised by the leaders and the rank and file of the trade union movement had made a great contribution to this country's economic recovery. It had never been the Government's policy to impose rates of wages, the Prime Minister stated, as the Government's view was that the well-tried machinery of collective bargaining should be maintained. He added that there was still a danger of an inflationary spiral, a danger that was manifestly increased by the new expenditure on armaments which it was necessary to incur.

Dealing more specifically with the armament programme, the Prime Minister said that every effort would be made to put the expanding production into areas where labour was available, or where there were signs that unemployment might develop. But in many instances, however, that would not be possible and there would have to be some redeployment of labour and some changeover of jobs. The Prime Minister went on to appeal for the co-operation of all trade unions and their members in order to ensure that urgent rearmament projects should not be left undermanned. Readjustments and some sacrifices would be entailed, but he asked trade unionists to smooth out any difficulties. The diversion of labour and resources from peace production to munitions, Mr. Attlee emphasised, must have some adverse effect on the amount of goods and services available to the community. But, he claimed, increased production and productivity, a fuller use of the country's capital equipment and still greater co-operation between workers and management could largely offset the adverse consequences.

The T.U.C. and Wages Policy

Wages policy was debated by the Trades Union Congress at Brighton on Thursday of last week, when Sir Vincent Tewson, the general secretary, presented the section of the General Council's report dealing with the economic situation.

The report included, of course, the General Council's latest pronouncement on wages, which was circulated to affiliated unions at the end of June. In that statement, it may be recalled, the General Council recognised that there must be greater flexibility of wage movements in the future than was envisaged in the policy approved by the conference of union executives in January. At the same time, the statement emphasised that it would be folly to assume that the economic barometer was set fair for the pursuance of wage claims. Increased efficiency and lower costs in industry were as necessary to-day as a year ago and it was pointed out that they were considerably dependent upon reasonable restraint in all personal claims on production.

But last week, at Brighton, delegates to the Congress expressed a different view. A resolution put forward by the Electrical Trades Union declared the "strongest opposition" to a continuation of the policy of wage restraint. The resolution claimed that wage increases could be met out of profits without resulting in increased prices, and called on the General Council to abandon any policy of wage restraint. Despite an appeal by Sir Vincent Tewson that Congress should reject the resolution, it was passed, on a card vote, by a narrow majority.

The London and S.E. Regional Board for Industry

A report by the Ministry of Labour, presented last week at a meeting of the London and South-Eastern Regional Board for Industry, stated that employment throughout the region continued at a high level. Vacancies at present outstanding, mainly for skilled engineering workers, had increased by more than 8000. In East London, the report noted, expansion in the motor vehicle industry continued and there had been a slight improvement in ship repairing. Firms making wireless and television cabinets were busy and there was a steady demand for women workers in the manufacture of dry batteries. In West London, more people were employed in electrical engineering and all branches of general engineering were also busy, with the demand for skilled workers exceeding the supply.

Another matter mentioned in the report was that recruitment in Scotland and Wales was being undertaken to meet a shortage of public vehicle drivers and conductors. Furthermore, one South London firm had attempted to recruit skilled labour in Scotland and the North-East but with only small success. In South London there was still an unsatisfied demand for skilled engineering workers. Throughout the whole of the region, the report observed, employers generally were optimistic and anticipated rising demands for labour during the next quarter, though the impact of the new defence programme on employment was not yet apparent.

Trade Disputes

The Ministry of Labour's latest report on stoppages of work through industrial disputes covers the month of July. In that month ninety such stoppages were in progress, involving 43,500 workers and causing a loss of 249,000 working days. Many of these stoppages occurred in the coal-mining industry. In Scotland, for example, there were several stoppages of work by coal miners, between July 3rd and July 24th, as a protest against the National Coal Board's refusal to increase the wages of lower paid workers. There were no stoppages of work in the engineering industry during July.

The Ministry has stated that eighty-one stoppages of work ended during July. Of that number, thirty-four, directly involving 2200 workers, lasted not more than one day; twelve, involving 2200 workers, lasted two days; nine, involving 1000 workers, lasted three days; twelve, involving 2700 workers, lasted from four to six days, and fourteen stoppages, involving 32,400 workers, lasted more than six days. In the first seven completed months of 1950 there were 838 stoppages of work through disputes reported to the Ministry. By them, 189,300 workpeople are estimated to have been affected, with a consequent loss of 837,000 working days. In the corresponding period of 1949 there were 887 stoppages, which involved 255,700 workers, and caused an aggregate loss of 1,189,000 working days.

Lectures on Higher Management

The London Centre of the Institute of Industrial Administration is arranging a further series of lectures on higher management under the general title "Policy: The Foundation of Management." The lectures will be delivered at Management House, Hill Street, London, W.1, on Wednesdays, September 27th, October 4th and 11th, at 6.30 p.m. The first two lectures are to be given by Mr. E. F. L. Brech, B.A., and will deal with the nature and scope of policy and policy formulation. The final lecture, dealing with interpretation and implementation of policy, will be given by Mr. Donald McDonald, B.Sc., F.I.M. The fee for the course is one guinea, and application for tickets should be made to Mr. W. T. Pope, 44, Horn Park Lane, London, S.E.12.

Remission of Duty on Imported Goods

In various Finance Acts provision has been made for the remission of duty on individual consignments of goods imported into this country. The sections of the Acts which relate to this matter are: Finance Act, 1932, Section 10, machinery; Finance Act, 1936, Section 5 (5), instruments and apparatus of a kind liable to key industry duty; Finance Act, 1936, Section 8, goods intended for non-commercial use in scientific research; Finance Act, 1949, Section 16, aircraft having a wing-span greater than 120ft, and parts or equipment of such aircraft, and Finance Act, 1950, Section 11, goods for industrial research.

For the convenience of importers, arrangements have now been made that all applications for remission of duty, under the terms of these provisions should be addressed in future to the Board of Trade, Industries and Manufacturers Department, Division 1B, Millbank, London, S.W.1. This Division will be responsible for the examination of each application, consulting, as necessary, the production departments concerned. Approved applications will then be submitted to the Treasury, which is empowered to authorise in appropriate cases the issue of duty-free licences or directions. Application forms and details of the exact scope of the provisions may be obtained from the Board of Trade at the above address.

It is pointed out, however, that these arrangements do not eliminate the need to make separate application for an import licence where it is necessary. Import licence applications and inquiries concerning them should be sent to the Board of Trade, Import Licensing Branch, Romney House, Tufton Street, London, S.W.1.

Labour Supply Problems

The annual report, covering the year 1949, of the Ministry of Labour, which has recently been published by H.M. Stationery Office (price four shillings), devotes a special chapter to labour supply problems. It records that, at the beginning of last year, a number of the essential industries and services were still undermanned. Nevertheless, it is claimed that considerable success was achieved in providing workers for essential work, both through publicity campaigns and through persuasion of individuals looking for fresh jobs to accept employment where they were most needed. Beyond those general measures, however, the report says that special consideration had to be given to difficulties that arose in particular industries and services.

The report states that in the industries classified as engineering, and manufacture and repair of electrical goods and vehicles, there were 2,572,000 people (2,094,000 men and youths and 478,000 women and girls) employed at the end of 1949, compared with a total of 2,557,000 at the end of 1948. Throughout last year there was an overall shortage of skilled operatives in the general engineering industry, the number of vacancies outstanding exceeding the number of skilled men employed. The extent of this shortage varied as between occupations and from area to area, but, the report notes, it was most marked in the occupations of moulder, turner, borer, driller, grinder, miller and wagon repairer. Despite the shortage of skilled men, however, the supply of operatives to this industrial group did not present, according to the report, any very acute problem during the year.

French Engineering News

(From our French Correspondent)

Since the Liberation private shipyards have constructed some 34,000 tons of naval shipping in 1947, 61,000 tons in 1948, and 162,000 tons in 1949. It is expected that 221,000 tons will be completed in 1950, but fewer vessels are being started this year.

Shipyards continued their modernisation in 1949, material being imported from England, and 108 machine tools being received from Germany as reparations. It is hoped that further machine tools will be received from one of the Kiel naval shipyards.

* * *

A new port at Marseilles, to be called the Marseille-Moureplane Port, will shortly be built. The port has been planned to receive large vessels and will have a depth of some 40ft of water at the quayside, over 1000 yards of quay being provided. Extensive marshalling yards and elevated roadways will be constructed to handle both passenger and goods traffic. A graving dock some 850ft long will also be built.

* * *

Six diesel-electric locomotives, each developing 610 h.p. at 760 r.p.m., have been purchased from the Sulzer Company by the French Occidental Africa Railway Company for service on the Dakar Niger Line.

They will haul three express trains of 256 tons. Although over part of the journey one locomotive would be sufficient, over the steeper inclines double heading of trains is necessary. Fuel consumption of the locomotives is about 7·6g per kilometre-ton. It is hoped that by the end of the year all the locomotives will have been delivered.

* * *

Several interesting civil engineering works are in progress in the neighbourhood of Paris at the present time. Some weeks ago the inauguration of the new port of Gennevilliers was mentioned in this column, and the works which are now in progress there are expected to be completed in 1955, a sum of 200 million francs having already been voted for them by the Greater Paris Municipal Board. When the six docks at the new port are completed, they will have a traffic capacity of some 3 million tons a year. A large part of the trans-shipping at present done at Rouen on the lower Seine will then become unnecessary, with a consequent reduction in transport costs. Gennevilliers lies at the centre of an important industrial region, and is well served by both railway and canal systems.

A large programme of main sewerage works is also in progress in the city. These works are being carried out by the Seine Sewer Service to obviate pollution of the Seine, and to improve the sewerage facilities generally. Several large-diameter trunk sewers are being constructed, and the work includes several inverted siphon crossings of the River Seine, such as at Sèvres-Achères, where lengths of piping of 3·25m internal diameter are floated into position and then sunk on to the river bed. The sewer pipes are of prestressed or reinforced concrete of very high quality and are made in a central casting yard. The mix proportions and water content of the concrete are carefully controlled, and the pipes are poured in steel shutters, vibrated externally. Thus, perfectly watertight pipes with smooth internal surfaces are produced.

MARINE CENTRIFUGAL PUMPING ENGINES.—Drysdale and Co., Ltd., has recently published a second and revised edition of a handbook entitled "Marine Centrifugal Pumping Engines." The book discusses general principles and the main design factors and goes on to describe the various pump parts, including advice upon alignment, overhaul and grades of lubricating oil. Part III is concerned with the engines, several of which are described and illustrated by sectional drawings. The new edition, which is well illustrated, concludes with a number of data charts, tables and useful memoranda, and will prove a useful guide for those responsible for the selection, installation and running of the company's pumping machinery.

Notes and Memoranda

Rail and Road

RENEWAL OF EAST LONDON LINE BRIDGE.—Recently a new 90ft span railway bridge, weighing 360 tons, was rolled into position to carry the East London Line over the Grand Surrey Canal at New Cross. The new bridge, comprising three steel plate girders, 93ft long by 10ft high, with steel and concrete decking, replaces a wrought-iron structure erected prior to 1869. An unusual feature of the work was that on one side of the canal it was necessary to provide trestles on piles driven 18ft into the bed of the canal to support the new bridge during erection and the old bridge during dismantling.

ADELAIDE RAILWAY ELECTRIFICATION.—A report on the proposed electrification of the suburban railways of Adelaide at a cost to South Australia of about £2,000,000 is being prepared by the Public Works Committee for submission to the State Government. The proposals before the Committee covered the electrification of the Adelaide Hills line as far as Belair, the Brighton–Marine line, the main north line as far as Dry Creek, the Henley-Grange line, and the Port Adelaide line as far as Outer Harbor. The total cost of the proposed electrification would be nearly £4,000,000, but under the Rail Standardisation Agreement Act, the Commonwealth Government would pay about 70 per cent of the cost.

RUBBERISED-ASPHALT ROADWAYS.—The Leicestershire County Council, in conjunction with Tarmac, Ltd., of Wolverhampton, and the British Rubber Development Board, is arranging for the construction of a stretch of rubberised-asphalt on roadway A447 between Hinckley and Ibstock, at the junction with the Market Harborough–Desford road (B585). Four sections of road are being laid: a normal roadway to serve as a control; a similar roadway with the addition of rubber powder; a normal roadway, but with a deficiency of binder, and a roadway with a deficiency of binder, but with the addition of rubber powder. The purpose of the sections deficient in binder material is that the life of the road will be shortened, and thus the advantages, if any, of the rubberised section will be apparent much sooner than if normal road surfacing material had been used. The roadway material used on all four sections will be a standard hot-mix, cold asphalt.

HISTORIC LOCOMOTIVE PRESENTED TO ROYAL ENGINEERS.—The Railway Executive has arranged to present to the Transportation Centre, Royal Engineers, for preservation on indefinite loan at the Centre's Museum at Longmoor (Hants) the historic inspection locomotive "Gazelle," which worked on the Shropshire and Montgomeryshire Railway during the period when this line was operated by the Royal Engineers as a miltary railway. On the S. and M. Railway being taken over by the Government, "Gazelle," with other former S. and M. engines, passed into British Railways' locomotive stock, but after fify-seven years' service it is unsuitable for further repair. "Gazelle" is probably the smallest locomotive ever built in this country for use on the standard gauge, having a weight of only 5 tons 6 cwt. It was built by Messrs. Alfred Dodman and Co. at King's Lynn in 1893 for the private use of a Mr. William Burkett. In 1911 it was bought for the S. and M. Railway, and for many years worked on the Criggion branch, and as an inspection engine. Originally of the 2–2–2 well tank arrangement, it was rebuilt as an 0–4–2 well tank about forty years ago. The engine still carries its original builders' plates.

Miscellanea

TEACHING AIDS IN ALUMINIUM TECHNOLOGY.—To fill a lack in the supply of educational matter concerning the aluminium industry, the Aluminium Development Association has recently issued Wall Chart No. 1, entitled "Aluminium Production—Mine to Metal," together with associated teachers' notes. These briefly discuss the distribution of Bauxite, reduction and fabrication centres, describe the various stages in the production of aluminium and an appendix includes interesting statistics.

THE LATE MR. F. C. WILLIAMS.—We regret to have to record the death, on Saturday, August 19th, of Mr. F. C. Williams, manager of the Cardiff branch office of G. and J. Weir, Ltd., Cathcart, Glasgow. Mr. Williams, who was in his sixty-fourth year, began his apprenticeship at Cathcart in November, 1902, and had much experience of marine fitting and repair work on the Clyde and of land installations in the Manchester area before taking up his work for the firm in South Wales and the West of England.

THE MACHINING OF COPPER AND ITS ALLOYS.—The Copper Development Association has recently issued a revised edition of its publication No. 34, entitled "The Machining of Copper and its Alloys," which was first issued in 1939. The handbook, which is well illustrated, deals with the classification of the copper alloys and then discusses general machining practice, mentioning the development of cutting tool materials. Several chapters deal with miscellaneous machining operations, and Chapter VII is devoted to the selection of copper alloys for machining purposes and the effect of composition on machinability. Appendices at the end of the handbook list standard specifications and give useful data.

AN ALUMINA PLANT IN BRITISH WEST INDIES.—The president of Aluminium, Ltd., recently announced that the ordering of equipment and detailed engineering planning will begin at once for the construction of the first alumina plant in the British West Indies. This plant is to be built in Jamaica at an initial cost of about eight million dollars and a new plant for conversion of bauxite into alumina will be built by Aluminium, Ltd.'s fully owned subsidiary, Jamaica Bauxites, Ltd. Plans for the Jamaican enterprise have been under consideration since 1942, just after the discovery of bauxite in Jamaica, as a supplementary and strategic source of bauxite supply for the large Canadian aluminium smelters.

PREPARING METAL SURFACES FOR PAINTING.—A Ministry of Works advisory leaflet just issued deals with preparing metal surfaces for painting. It describes in non-technical language the treatment needed before painting iron and steel, and recommends the best types of priming paints to use. Similar information is given for non-ferrous metals—aluminium, zinc, lead and copper. In the treatment of iron and steel the operator's attention is drawn to the need for giving special care to rivets, bolt heads, and welds, both when dealing with new factory products already primed and when repainting; to the danger of rusting from moisture trapped beneath the paint; to the advisability of priming edges first, before painting the whole surface.

INSTITUTION OF BRITISH AGRICULTURAL ENGINEERS.—In view of correspondence and inquiries received by the Institution of British Agricultural Engineers about the possibility of a professional examination for agricultural engineers in this country, the Education Committee and Council have given serious consideration to the problem of an examination for associate members. The Council hopes to make an announcement concerning an examination for a National Diploma in Agricultural Engineering which would be recognised as an examination preliminary to corporate membership of the Institution. The Council is at present unable to undertake any correspondence on this subject, but hopes to publish full information at the beginning of October.

Contracts

DETAILS have been announced of a half-million-pound contract placed by the Pakistan Government with the South Wales firm of Aberdare Cables, Ltd. The contract covers the complete supply and installation of all electrical equipment for a large manufacturing undertaking in Pakistan. Electrical power will be supplied from existing sources, but the contract includes several miles of overhead line to the site. Electrical power is to be supplied to a wide area. Overhead line, E.H.T. and L.T. cables are being manufactured at the Aberdare Cables' factory, and South Wales Switchgear, Ltd., is supplying all switchgear and transformers from the Blackwood and Treforest factories respectively. The complete installation on site will be carried out by Aberfren Cable and Construction Company, Ltd.

IN connection with the power supply expansion scheme recently announced by the Electricity Supply Commission of South Africa, Metropolitan-Vickers Electrical Company, Ltd., of Trafford Park, Manchester, has received an order for two 30,000kW, 3000 r.p.m. turbo-generator sets for the Salt River No. 2 station, Cape Town. The consultants are Messrs. Merz and McLellan. The turbines are designed for initial steam conditions of 600 lb square inch gauge, 900 deg. Fah., and a vacuum of 29·0in Hg. at the economic rating of 24,000kW. Two-cylinder construction will be employed; the h.p. cylinders will contain twenty-three impulse stages, and the double-flow l.p. cylinders will contain six stages in each flow. Four-stage feed heating will provide a final feed temperature of 340 deg. Fah. at the economic rating.

British Patent Specifications

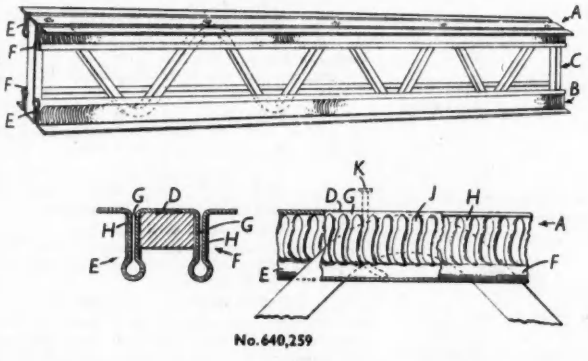
When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification.

Copies of specifications may be obtained at the Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, W.C.2, 2s. each.

STRUCTURAL ENGINEERING

640,259. April 29, 1947.—IMPROVEMENT IN BUILT-UP STRUCTURAL ELEMENTS, Herbert Corliss Fischer and Allan Herbert Webster Higgins, of 3, Sawyer Road, Wellesley Hills, and 6, Joy Street, Boston, Massachusetts, U.S.A.

This invention relates to built-up structural building elements and more particularly to an open-web beam or column which is so constructed as to permit attachment of collateral building members thereto by driven fasteners. Its object is to provide a low-cost, light-weight structural element capable of receiving and holding driven fasteners. A further object of the invention is to provide a built-up structural element of the character referred to which provides a plurality of lines of nailing without the use of separate detachable nailing strips. Referring to the drawings, the assembled structural element comprises an upper chord, indicated generally at *A*, a lower chord *B*, and an intervening web *C* holding the two chords in spaced relationship and serving to stiffen the member against deflection under transverse stresses in the usual manner. The upper and lower chords are preferably identical in construction; each comprises a onepiece, shaped member of uniform cross section throughout its length. The chord member comprises a central portion *D*, having depending at each side fastener-holding projections *E* and *F* provided by bending the strip stock from which the chord member is formed. Each of the projections includes an inner wall *G* extending approximately at right angles to the flat surfaces of the central portion, and an outer wall *H* spaced slightly from the inner wall and lying generally parallel to it. The walls are connected at their lower ends by a tubular portion continuous with the inner and outer walls. Both of the walls *G* and *H* in each of the projections *E* and *F* are deformed to provide a series of spaced ribs *J* which are struck inwardly from the metal. Driven fasteners, such as the nail *K*, to be received and held in the projections *E* and *F* are driven downwardly between the walls *G* and *H*.—*July* 19, 1950.

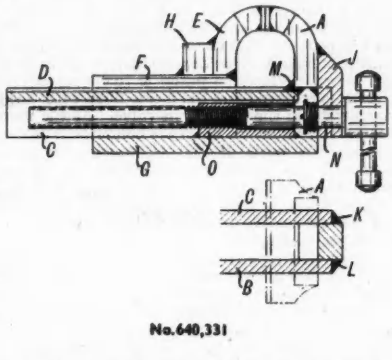


No. 640,259

TOOLS AND WORKSHOP APPLIANCES

640,331. March 17, 1948.—IMPROVEMENTS IN AND RELATING TO PARALLEL VICES, Kaare Omsted, of Grev Wedels plass 4, Oslo, Norway.

The invention relates to parallel vices of the type wherein the movable jaw is welded to the slide member. The other parts of the vice may be made by casting, or preferably by building up welded pieces of wrought iron. In such vices it has hitherto been difficult to make the connection between the movable jaw and slide member of sufficient strength, and an object of the present invention is to obviate this difficulty. In the drawing *A* is the movable jaw member and *B* and *C* are the side walls and *D* the top plate of the slide member to which the jaw *A* is welded. The stationary jaw member *E* is welded to the top plate *F* and the side walls of the guide member enclosing the slide member, the said walls being welded to the base-plate *G* of the vice and an anvil piece *H* being so situated and welded as to stiffen the connection between the jaw *E* and the top plate *F*. The jaw member *A* is connected to the slide member by means of the end piece *J*, which is located between the ends of the side walls of the slide and welded to the same; these walls are not carried right up to the outer face of the end piece so that step-like recesses *K* and *L* are formed which may be more or less completely filled with welding material. The lower face of the jaw member *A* is welded to the end edge of the top plate *D* of the slide member as at *M* and also to the top face of the side walls *B* and *C* of the slide member. The pinching or clamping screw *N* is



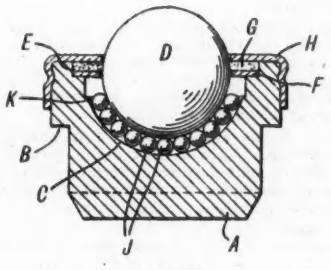
No. 640,331

carried through a bore in the end member *J* and is in screw threaded engagement with a nut *O*, which is welded to the base plate *G* of the vice. The end piece *J* serves to transmit the movement of translation of the screw to the slide member and further serves as a buttressing member for resisting the clamping reaction on the movable jaw.—*July* 19, 1950.

MISCELLANEOUS

641,016. December 18, 1947.—IMPROVEMENTS IN BALL CASTORS, J. Collis and Sons, Ltd., of 42 and 43, Regent Square, Gray's Inn Road, London, W.C.1, and Leslie Alfred Collis, of "Spinney Close," Aldenham Avenue, Radlett, Hertfordshire.

This invention relates to ball castors particularly applicable to transfer tables. Such tables are used in a gravity roller conveyor system, or similar equipment, when set up on the horizontal and may be used for turning packages in the horizontal plane. Referring to the accompanying drawing, the ball castor illustrated comprises a plug *A* which is shouldered, as at *B*, to fit into a suitable recess

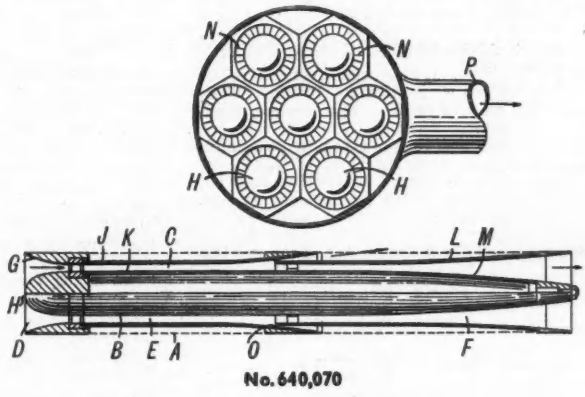


No. 641,016

in the transfer table, the plug being provided in its upper surface with a hemispherical socket *C* to house the ball *D* of the castor. The upper surface of the plug around the top of the socket is recessed as at *E* to receive an annular keeper plate *F* over which is laid a felt or like washer *G* to exclude dirt. The ball *D*, keeper plate *F*, and washer *G* are kept in position by means of an annular cap *H*. The socket is larger than the ball *D*, and between these two parts are arranged a number of balls *J* so that friction tending to retard the free movement of the ball *D* in the socket is reduced to a minimum by the elimination of sliding friction. It will be appreciated that as the ball *D* turns in its socket the balls *J* will ride up the surface of the socket *C* to the rear of the ball *D*, and it is desirable to provide means for preventing this movement causing the balls *J* to jam up against the keeper plate *F*, particularly where heavy loads are to be applied to the ball. With this object in view the upper portion of the socket is cut away slightly as at *K* to form a clearance about the top. This clearance need not be great since all that is necessary is that when the balls *J* reach the lip of the socket they should be freed from the grip between the ball *D* and the socket *C*. The balls as they reach the clearance at *K* will flow round the ball *D* until they reach a place where there is free space between the ball *D* and the socket *C*, whereupon they will move down between these two parts under the action of gravity and/or due to the pressure of the following balls, to resume their normal function. In an alternative construction the socket is continued upwardly with parallel sides beyond the true hemisphere and beyond the centre of the ball to provide the desired clearance.—*August* 2, 1950.

640,070. January 26, 1948.—IMPROVEMENTS IN OR RELATING TO NON-ROTARY CENTRIFUGAL SEPARATORS, Power Jets (Research and Development) Ltd., of 25, Green Street, London, W.1, Inventor, Laurie Edward Richard Umney.

This invention is for improvements in or relating to non-rotary centrifugal separators for operating on fluid media and in particular for separating dust and dirt from air or gaseous media. The separator (see drawing) consists of an open-ended tubular member *A* and a streamlined core member *B* contained within the tubular member, the two defining and forming between them an annular passage *C* through which the air or gas is passed. The tubular member and the core member are shaped to form a smoothly accelerating entry portion *D*, a stabilising portion *E* and a smoothly diffusing exit portion *F*. The smoothly accelerating entry portion *D* is formed between the sharply converging inner wall *G* of the tubular member *A* and the streamlined bullet-shaped nose portion *H* of the core member *B*, the two defining a short convergent annular passage of sharply decreasing cross sectional area. The stabilising portion is formed between long walls *J* and *K* of the tubular member and the core member respectively. The diffusing or diffuser exit portion *F* is formed between the slowly diverging inner wall *L* of the tubular member *A* and the slowly converging wall *M* of the core member *B*, the two defining a long diverging annular passage of slowly increasing cross sectional area. At the junction of the accelerating entry portion *D* and the stabilising portion *E* a ring of vanes *N* is arranged to cause the accelerated dusty and dirty entry air or gas to whirl about the axis of the separator in a helical path and form a vortex in the stabilising portion *E* where it stabilises itself. An annular opening *O* is formed between the junction of the stabilising portion and the diffusing exit portion *F* for skimming off the outer layer or layers of the whirling air or gas and the foreign matter contained therein. A number of separators may be arranged to nest together in parallel as shown in the drawing. The chamber is provided with an exhaust duct *P* for discharging the air or gas containing the foreign matter either to atmosphere or to a further separator.—*July* 12, 1950.

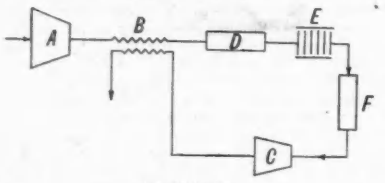


No. 640,070

GAS TURBINES

624,291. June 27, 1947.—Improvements in or relating to Gas Turbines, C. A. Parsons and Co., Ltd., of Heaton Works, Newcastle-upon-Tyne, 6, and Andrew Thomson Bowden, of the company's address.

In gas turbine plant working according to an "open" or "mixed" cycle the fuel used is burned directly in air compressed to a suitable pressure above atmospheric and the resultant products of combustion together with additional diluent air forms the working medium which is expanded in one or more turbines, thus producing useful power. The object of the invention is to prevent or inhibit the harmful effects of the constituents in the working medium arising from the combustion of the fuel



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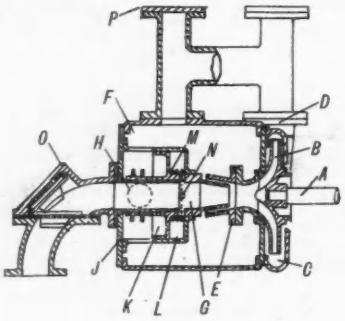
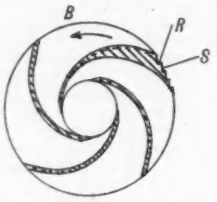
or by being brought in with the combustion and/or diluent air. In the drawing air from a compressor *A* passes through a heat exchanger *B*, where it picks up heat from the exhaust gases discharged by a turbine *C*. After combustion in a combustion chamber *D* the products of combustion pass through an extractor *E* and the constituents which would adhere to the turbine blading or auxiliary equipment, such as, for example, the heat exchanger, are deposited on the surfaces of the extractor. The combustion takes place in two stages, one before the extractor in the combustion chamber *D* and the other in a combustion chamber *F*, following the extractor. Thereafter the products of combustion are expanded in the turbine *D* and are then led through the heat exchanger *B* to atmosphere. The process permits of using in the first combustion stage or stages grades of fuel that are in general cheaper than those which do not give rise on combustion to products harmful to the output and/or efficiency of the turbine and its associated components. An alternative arrangement showing duplicate extractors is given.—*Amended Specification Published July* 19, 1950.

PUMPING AND BLOWING MACHINERY

636,848. May 19, 1948.—Improvements in or relating to Centrifugal Pumps, Sidney Zaleski Hall, of 30, Twemlow Avenue, Parkstone, Dorset.

The object of this invention is to provide a simple type of self-priming centrifugal pump which can be either vertical or horizontal and which does not require a non-return valve on the delivery side. The centrifugal pump, as shown in the drawing, is of a normal type fitted with a horizontal shaft *A* carrying the impeller *B* fixed to it and rotating in a





No. 636,848

casing *C* provided with a delivery branch *D*. The suction pipe *E* is fitted with a cone piece with the wider end away from the pump casing. This piece can be cast in one with the suction branch, if desired. The priming chamber *F* is fastened to the suction branch and is connected by pipes with the pump delivery *D*. The nozzle ended slidable suction pipe *G* is carried on a cylinder *H* fastened to the end cover *J*. Attached to the slidable suction pipe *G* is a piston *K* of larger diameter, sliding in a cylinder *L* fastened to the cover *J* and fitted with holes to allow the water to press on that side of the piston remote from the spring *M*. The larger cone end is machined as a valve seat and the face on the slidable suction pipe is also machined as a valve seat. Holes *N* are drilled through the slidable suction pipe connecting the space between the piston and the cylinder head with the suction pipe. The special non-return valve fitted to the pump is made with its branches at right angles, so that the valve can be easily examined by removing the top part *O*. The valve and the outside joint is made of rubber or other flexible material to make its own hinge. When the pump is to be started the cover *P* is removed and the inside filled with water, which rests on the non-return valve. As the pump rotates water is drawn down the hollow cone passage between the parts *E* and *G*, causing a partial vacuum in the suction pipe, which causes the non-return valve to lift and admit air, the mixture of air and water is delivered by the pump impeller and the air passes through the delivery pipe and the water returns to be re-pumped. The vacuum in the suction pipe is being continuously increased by the hollow cone of water being delivered to the pump suction. As soon as all the air has been exhausted the pressure on the delivery side increases and this pressure comes back to the piston *K* and combined with the negative vacuum presses the slidable suction pipe towards the pump until the two valve faces meet. In order to increase the suction lift under which the pump will prime, the impeller *B* is modified as shown in the lower view. The vanes on the convex side are not altered, but the outer ends of each vane on the concave side are thickened up and provide a smooth curve back to nearly the inside end of the vane. On the outside of this thickened portion teeth *R* are cut, the short side *S* being approximately radial to catch the air bubbles entrained in the water when priming.—*May* 10, 1950.

Personal and Business

Mr. W. D. Akester has been elected to the board of Ransomes, Sims and Jefferies, Ltd., of Ipswich.

E. Boydell and Co., Ltd., Manchester, 16, announces the appointment of Mr. Wm. F. McCaw as chief engineer.

Mr. R. H. Cooke, of Philips Electrical, Ltd., has been appointed assistant manager of the company's X-ray department.

Mr. A. Binns, M.I.Mech.E., has been appointed manager of the Testing Machine Division of W. and T. Avery, Ltd., Birmingham.

The British Electricity Authority has appointed Mr. E. L. Gethin, B.Sc., A.M.I.E.E., as Deputy Chief Contracts Officer.

The Brush Electrical Engineering Company, Ltd., announces that it has acquired a controlling interest in the Vivian Diesel Engine Works, Ltd., Vancouver, British Columbia.

Dowding and Doll, Ltd., Greycoat Street, Westminster, S.W.1, has appointed Angloamerica, S.A., rua tres de dezembro 43, Sao Paulo, as agent in Brazil for its British-made range of machine tools.

Ronson Products, Ltd., announces the retirement of Mr. J. E. Liddiatt, managing director of the British company since its formation in 1929. Mr. Kenyon W. J. Jones has joined the board of the company.

Dowding and Doll, Ltd., Greycoat Street, Westminster, S.W.1, has appointed Machine Tools (India), Ltd., of Stephen House, Dalhousie Square, Calcutta, India, as sole agents for India, Kashmir, Nepal and Burma for its British-made range of machine tools.

The General Electric Company, Ltd., announces the appointment of Mr. J. P. Huggard as chief designer in the engineering department at Witton, in succession to Dr. R. G. Jakeman, who has retired. Mr. V. Easton has been appointed project development engineer.

A. A. Jones and Shipman, Ltd., Narborough Road South, Leicester, has been appointed the sole selling agents in Great Britain for the complete range of machines manufactured by Ex-Cell-O Corporation, Detroit, U.S.A. Following the addition of this agency and the recent agreement with the Micromatic Hone Corporation of Detroit for the manufacture and sales in Great Britain of its honing machines and equipment, Mr. Jack Humphries has been appointed sales manager, American Equipment Division, of the company. We are informed that Mr. Humphries will shortly visit the United States to obtain first-hand information on the products and make personal contact with the American companies.

The Skinningrove Iron Company, Ltd., states that Mr. Vaughan Pendred is resigning his position of general sales manager on November 30th in order to take up an appointment in charge of the sales organisation of the Head Wrightson group of companies. Mr. Paul Redway, assistant sales manager at Skinningrove, will succeed Mr. Pendred as general sales manager of that company on December 1st.

Sir George Godfrey and Partners, Ltd., Hampton Road, Hanworth, Middlesex, has undertaken a major reorganisation in the structure of the company. As a result there are three new companies, Sir George Godfrey and Partners (Holdings), Ltd., which is the financial controlling company, with two subsidiaries, Sir George Godfrey and Partners, Ltd., which will continue to specialise in aircraft pressurisation and air conditioning equipment, and Sir George Godfrey and Partners (industrial), Ltd., which has been formed to deal with industrial interests. Three new directors have joined the boards of the subsidiary companies:—Mr. R. W. Everall, who becomes a director and general manager of the aviation interests; Mr. Fisher, the firm's chief accountant and secretary, is now a director of the industrial company; and Mr. N. Anderson, who was chief engineer of Sir George Godfrey and Partners, Ltd., has been appointed to the board of the aviation company.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Association of British Chemical Manufacturers

Fri., Sept. 29th, to Sun., Oct. 1st.—Chemical Works Safety Conference at Scarborough.

Association of Supervising Electrical Engineers

Mon., Sept. 18th.—Central London Branch: St. Ermins Hotel, London, S.W.1, "Radio Interference Suppressors," H. Andrewes, 6.50 p.m.——Stockport Branch: White Lion Hotel, Underbank, Stockport, "Lighting," Mr. Gostt, 8 p.m.

Wed., Sept. 20th.—Manchester Branch: Engineers' Club, Albert Square, Manchester, Film Show, 7.30 p.m.

British Institution of Radio Engineers

Wed., Sept. 27th.—London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1, Annual General Meeting, 6.30 p.m.

Incorporated Plant Engineers

Tues., Sept. 19th.—Glasgow Branch: Engineering Centre, 351, Sauchiehall Street, Glasgow, "Training of Apprentices for Plant Maintenance," W. Derby, 7 p.m.

Institute of Marine Engineers

Thurs., Sept. 28th.—83, Minories, E.C.3, Presidential Address, Sir A. Murray Stephen, 5.30 p.m.

Institute of Metals

Mon., Sept. 18th, to Fri., Sept. 22nd.—Forty-Second Annual Autumn Meeting at Bournemouth.

Institution of Civil Engineers

Thurs., Sept. 21st.—Yorkshire Association: Visit to G. and T. Earle, Ltd., Cement Manufacturing Works, Hope, near Sheffield, 9.45 a.m.

Institution of Engineering Inspection

Wed., Sept. 20th.—Dundee Branch: School of Economics, Dundee, "Some Aspects of Thread Grinding," Mr. Perry, 7.30 p.m.

Institution of Locomotive Engineers

Wed., Sept. 20th.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1, "Locomotive Testing on British Railways, D. R. Carling, 5.30 p.m.

Institution of Mechanical Engineers

Sat., Sept. 23rd.—N.W. Branch, Graduates' Section: Engineers' Club, Albert Square, Manchester, "'This I have read in a book,' he said, 'and this was told to me,'" H. Wright Baker, 2.30 p.m.

Tues., Sept. 26th.—S. Wales Branch: Mackworth Hotel, Swansea, "Some Gas Producer Problems," H. F. Phillips, 6 p.m.

Institution of Metallurgists

To-day to Sat., Sept. 30th.—Science Museum, South Kensington, London, S.W.7, Exhibition, "Metals in the Service of Mankind," weekdays, 10.0 a.m. to 6.0 p.m.; Sundays, 2.30 p.m. to 6.0 p.m.

Institution of Mining and Metallurgy

Tues., Sept. 19th, to Sat., Sept. 23rd.—Conference on Wire Ropes in Mines, at Ashorne Hill, Leamington Spa, Warwickshire.

Institution of Production Engineers

Mon., Sept. 18th.—Derby Sub-Section: School of Art, Green Lane, Derby, "Zirconium-Magnesium Alloys," J. B. Wilson, 7 p.m.

Tues., Sept. 19th.—Coventry Section: Geisha Cafe, Hertford Street, Coventry, Joint Discussion on "Design for Production," 7.15 p.m.

Wed., Sept. 20th.—Birmingham Section: James Watt Memorial Institute, Great Charles Street, Birmingham, 3, "Fundamentals of Production Management," M. Seaman, 7 p.m.